Hazardous Gas Monitoring System In Industries And Washrooms

Divya.R, Latchaprabhu.P, Nishashree.R, Nivetha N.J, R. Kavitha

Abstract: ***A gas detector is a vital device in industries that detects the presence of hazardous gases often as part of a safety system. This type of equipment is used to detect a gas leak or other emissions and provide signal and alarm giving the employees the opportunity to evacuate. The main idea of this project is to apply gas monitoring system in washroom and industry. In India most of the washrooms are not clean regularly which leads to lots of hygienic problem and restricts the usage of public. The main gases in the washroom are hydrogen sulfide, methane, ammonia, carbonmonoxide and nitrogen oxides. This project is proposed to initiate the use of public washrooms in India without any hesitation. The gases are detected using sensors MQ-4, TGS-2602andMQ-136 respectively and GSM will send a message to the server GSM, which will indicate washroom should be cleaned.***

Keywords: obstacle detection, Electronic travel aid, indoor navigation, light fidelity.

I. INTRODUCTION

In India there are several washrooms which are not used by the people, the main reason for this scenario is that those wash rooms are unhygienic to use. These washrooms are not cleaned properly and regularly which makes the mun safe to use. One of the main harmful things in the washrooms are the gases from the decayed matter which has heavy odor and has harmful content. These gases on inhaling above some limit created suffocation, eye irritation, etc. The gradual effects are asthma and other respiratory disease. To eliminate the above stated problem the gases from the washroom are monitored using a sensor setup. The threshold of the gas intensities is obtained from the previous surveys and from the health-based records. If the gas intensity in the washroom exceeds the threshold value then there is a signal sent to the main server area. The main server area is a place where the washroom routing-based activities are planned. These activities include cleaning, building and abor management. If any signal is received in the server area then the server will send the appropriate people to the washroom which will be cleaned by them. An additional feature is added to this project, which will monitor the dustbin if the dustbin is full then there will be a signal sent to the man server area. This project is not only restricted to washrooms these can be equipped in the factoriesq. sIn sugar industries associated with distillery this project can be implemented. Sugar industries use Sulphur dioxide for their process and they produce alcohol. The inhalation of Sulphur dioxide leads to irritation of nose, throat, and airways which causes coughing, wheezing, shortness of breath, or a tight feeling around the chest. To avoid the above-mentioned issues our module is modified and developed for industrial purpose. This module will detect alcohol and Sulphur dioxide when leaks and sends message to the respective authorities. The objective of gas monitoring is two-fold: To detect the gases, present in washroom like methane, carbon monoxide and hydrogen dioxide using MQ-4, MQ-135, and TGS-2602 and to send message to intimate the washroom status To detect Sulphur dioxide and alcohol, present in sugar industry using MQ-4 and TGS-2602 and to interface EK—TM4C1294XL and GSM to send message and intimate the gas leakage to industry.

The entire population of India requires public washroom when they travel. But only 20 % of Indians only use common washrooms. The rest 85 % don't use this because of fully filled dustbin and dirty smell which may lead them to health issues. Government needs a cost-efficient system to enhance the use of washrooms by the rest 85% [1]. This project will help to clean the regularly uses washroom regularly and scarcely used washroom when it becomes unsafe to use. This project fulfills both user and the government norms Pre-existing technology is comparatively complex and costly. They are fully automated and they are not best suited for India. [2].

The gases in the washroom are Methane, Carbon monoxide and Hydrogen Sulfide and these gases are harmful. This module has two sub module they are client module and server module as shown in fig.1 and fig. 2. The client module will be placed in the washroom and the server module will be placed in the washroom maintenance department. In client module there are methane gas sensor, ammonia gas sensor and hydrogen sulfide gas sensor. These sensors on detecting high threshold level of gas will send SMS to the server module and in the server module the message is received through GSM and the message is displayed in the mobile app. If the gas sensor detects the medium threshold then the exhaust fan and the disinfectant releasing pump will be switched on.

Another part in the client module is dust bin's level detection this is done by touch sensor, if the dust bin is full then it will send SMS.

The server module will receive message using GSM that interacts with the microcontroller and display the message in the mobile application The gas monitoring system in

Revised Version Manuscript Received on 22 December, 2018

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petrochemical Industries has been studied in [4]. The literature [5-7] provides review of Ubiquitous Monitoring of Gases employing Internet of Things and Industrial Internet.Electronic nose in [8] is aimproved substitute for assessing the complex industrial emissions over other analytical techniques. Security issues in data communication are discussed [9].

In sugar manufacturing process Sulphur dioxide is used to bleach the sugar cane juice and syrup. This process is called "double Sulphitation". In the second stage sugar syrup concentrated juice is Sulphitation. Sulphur dioxide gas is produced in equipment called Sulphur burner. In the Sulphur burner the molten Sulphur is burned in a controlled atmosphere to produced flames are scrubbed and cooled in a series of piping. The clean Sulphur dioxide gas is sparked through the column of juice/ syrup in a cylindrical vessel called juice /syrup Sulphitators.

During the above-mentioned process there is a chance for leakage of Sulphur dioxide gas through mating flanges and value fitting. In this aspect a gas monitoring system is developed which detects the Sulphur dioxide gas and sends message to the respective authorities. This model is implemented as shown in fig. 2 and the output is obtained in distillery, industrial alcohol is being produced by fermenting the sugar cane molasses.[10-12] The fermented liquor is passed through series of distillation columns to get the industrial alcohol. Industrial alcohol is a major product in the distillery. So, to detect leakage of alcohol, sensor TGS26012 is employed and it will send message to the authorities. The chemicals like ammonia and phenol are also tested in the industrial laboratory of the sugar Industry. The threshold values of various sensors used in the project are shown in Table 1.

Gas	Medium level (ratio)	High level (ratio)
Methane	1.40	1.00
Carbon monoxide	2.00	1.60
Hydrogen Sulfide	0.5	0.3
Sulphur Dioxide	3.50	3.00
Alcohol	0.7	0.2

Table 1. Threshold level table

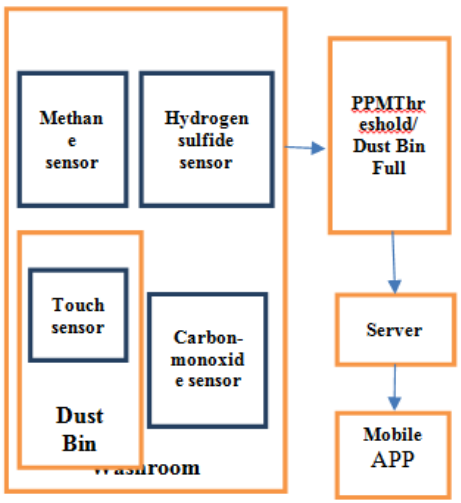

Fig 1. Automated Washroom system

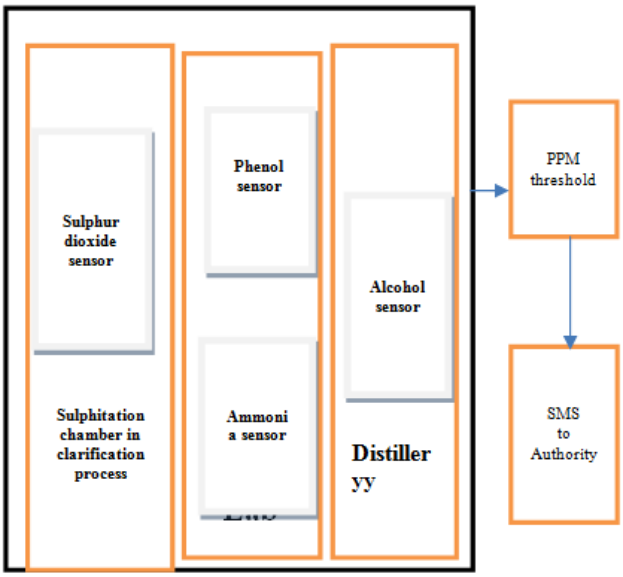

Fig 2. Industrial Gas monitoring system

The module has two sub modules they are server module and the client module. The server module will be in the main server area where washroom operations are planned.

The client module will be placed in washrooms where gases are to be monitored. The MQ-4 sensor detects the concentration of methane gas in the Washroom and outputs its reading as an analog voltage. The concentration sensing range of 300 ppm to10,000ppm. The sensor consumes less than 150 mA at 5 V. Sensitive for Methane, CNG Gas. The MQ-135 sensor detects the concentration of NH3 (Ammonia), NOx, alcohol in the Washroom and outputs its reading as an analog voltage. Output voltage boosts along with the concentration of the measured gases increases. The TGS-2602 sensor detects Hydrogen Sulfide, Toluene and alcohol. It can sense gases from 0.1 ppm to 3 ppm. The touch sensor is a digital sensor. The sensor circuit closes when it is touched by any material. This sensor is used to detect whether the dustbin is full or not.

The TM4C1294 Connected Launch Pad Evaluation Kit is a development platform for ARM Cortex-M4F-based microcontrollers which has TM4C1294NCPDTMCU with itson-chip10/100 Ethernet MAC and PHY, USB 2.0, hibernation module, motion control pulse-width modulation and a multitude of simultaneous serial connectivity. GSM/GPRS Modem-RS232 is built with Dual Band GSM/GPRS engine- SIM900A, works on frequencies900/1800MHz. It is used to send message in the client module and receive message in server module. Exhaust fan is used when the gas level is high and removes moisture and odors from the bathroom by expelling the suctioned airfrom the room, via the industries, through ductwork, and out the roof or overhanging soffit. The exhaust fan works on 12V.Automatic pump is switched on when the gas level is medium and the pump works on 12V.

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P (Arduino Nano 3.x). It has more or less the same functionality of the

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ArduinoDemilune, but in a different package. It lacks only a DC power jack, and workwith a Mini-B USB cable instead of a standard one

II. METHODOLOGY

The algorithm of the process is discussed in this section. Initialize pin number A0, A1 and A2 or MQ-4, MQ-135 and TGS-2602 sensors respectively.Connect the analog output of the sensors to their respective pins based on the initialization. Upload the complete code to the launch padand select Baud rate to check the sensor readings.Check whether any of the gas readings exceeds the threshold value (high ppm) if yes Send the unique identification code of the washroom to the server

TGS-2602 sensor (hydrogen sulfide gas)			TGS-2602 sensor (alcohol
Ratio		Ppm	Ratio Ppm
0.8	0.1	0.8	1
0.7	0.2	0.75	2
0.6	0.3	0.7	3
0.5	0.4	0.65	4
0.48	0.6	0.6	5
0.44	0.7	0.55	6
0.42	0.8	0.5	7
0.41	0.9	0.4	8
0.4	1	0.3	9
0.3	2	0.2	10
0.25	3	0.15	20

Table 5. Solvents and response of sensors

The datasheet has a sensitivity characteristic which gives the corresponding PPM values with respect to the ratio as shown in table 2 and 3. The ratio in the project is sensed by EK-TM4C1294XL and corresponding PPM level look up table is referred for indicating medium and high level. The hazardous ppm levels of all gases are shown in Table 4.

MQ-4 sensor (methane gas)		MQ-4 sensor (Sulphur dioxide gas)		MQ-135 sensor (carbon monoxide gas)	
Ratio	Ppm	Ratio	Ppm	Ratio	Ppm
1.8	200	4.0	200	2.9	10
1.6	300	3.9	300	2.5	15
1.5	400	3.8	400	2.3	20
1.4	500	3.7	500	2.1	30
1.3	600	3.6	600	2.0	40
1.2	700	3.5	700	1.85	50
1.1	800	3.4	800	1.8	60
1.05	900	3.2	900	1.75	70
1	1000	3.1	1000	1.7	80
0.8	2000	3.0	2000	1.68	90
0.5	4000	2.9	3000	1.6	100
0.42	6000	2.7	5000	1.55	150
0.32	10000	2.5	10000	1.5	200

Table 2. Ratio of sensors and corresponding PPM levels MQ-4 and MQ-135:

Module exposed to	Ratio in MQ-4	Ratio in MQ-135	Ratio in TGS-2602
Air (normal level)	4.5	3.5	1.0
Organic solvent	3.0	2.5	0.81
Sulphur flames	1.73	2.85	1.4
Alcohol	2.24	1.80	0.08
Phenol	3.03	4.06	0.15
Ammonia	2.83	2.23	0.54

Table 3. Ratio of sensors and corresponding PPM levels TGS-2602:

Table 4. Hazardous level of gases

Gas	Hazardous ppm level(ppm)
Hydrogen Sulfide	>2
Carbon monoxide	>40
Methane	>1000
Sulphur dioxide	>200
Alcohol vapor	>10

III. EXPERIMENTAL RESULTS:

The module is exposed to organic solvent and the values are tabulated in Table 5.The module is exposed to Sulphur vapors in Sulphatation chamber and the values obtained are tabulated in table 6 and the apparatus is shown in fig 4.The module with MQ4 sensor is exposed to alcohol vapors, the results obtained and are tabulated in Table5 and the apparatus is shown in fig.5 and the prototype is shown in fig 6.The graph marked in black indicates the gases that responds in most sensitive and detected by the particular sensor and it is shown in fig .7-9 respectively.

Fig 3. Image of testing with ammonia

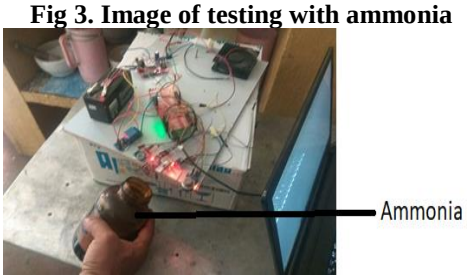

Fig 4. Image of testing with Sulphur

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Fig 5. Image of testing with Alcohol

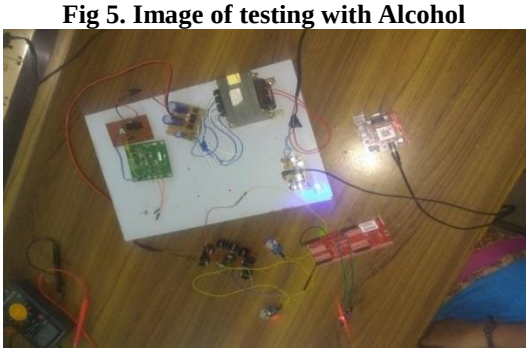

Fig 6.Client and server module

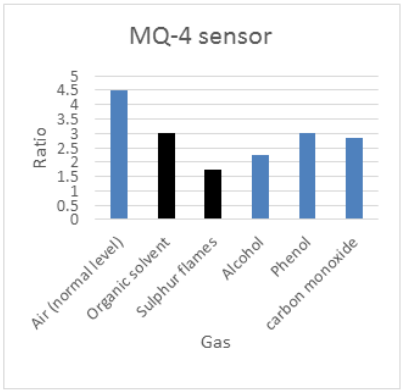

Fig 7. Response for MQ-4 sensor

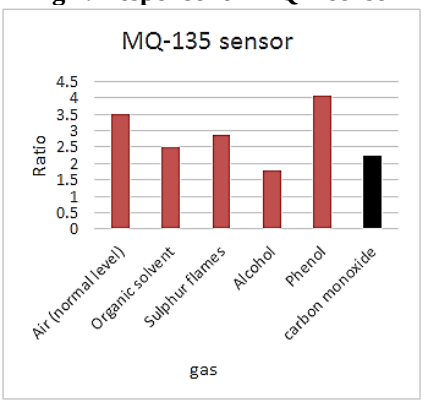

Fig 8.Response of MQ-135 sensor

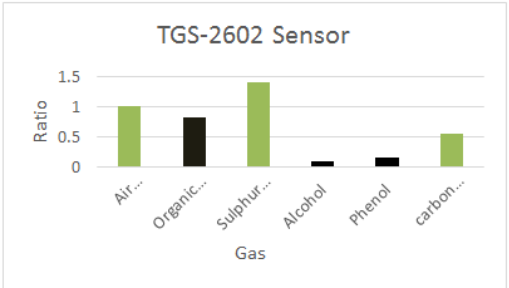

Fig 9. Response of TGS-2602 sensor

IV. CONCLUSION

The sensors MQ-4, MQ-135 and TGS-2602 are calibrated and the gases are detected using sensors, the microcontroller EK-TM4C1294XL is used to indicate the status (Washroom number). The gas levels are classified into medium level and high level based on the PPM level. If the detected level is medium then the fan and the exhaust fan are turned on in the washroom, if the detected level is high SMS is sent to server module. The server module displays the washroom number in the mobile app.

This setup is tested in clarification chamber and distillery of SugarIndustry with MQ-4 and TGS-2602 sensors respectively. On detection of gas leakage message is sent to authority.

MQ-4 gas is highly sensitive to Sulphur dioxide, MQ-135 gas sensor is highly sensitive to carbon monoxide and TGS-2602 is highly sensitive to organic compounds

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