Detection of Toxic Gases using Arduino and GSM Network

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***Abstract* -The main objective of this project is to detect the toxic gases while cleaning the drainage. During the cleaning process the toxic gases like nitrogen oxide, carbon monoxide and other gases are emitted. It can be detected by different sensors and indicated to alert the users and also a warning message is send to the base station to make the safety measures to the workers from the effect of toxic gases. Hence the system will help to solve the problem while cleaning the drainage.**

Keywords: CO,CH4,GSM

I. INTRODUCTION

A. CAUSES OF TOXIC GASES:

The increase in the development of technology and the human race, we failed to take care about the surroundings in which we live in. Thus we polluted the environment and thereby reducing the quality of the place we live. Even though there are several aspects of pollution such as soil, air and water pollution, out of these air pollution acts as the serious aspect as the other can detected visually and by taste, but the polluted air cannot be detected as it can be odorless, tasteless and colorless. Hence there is a growing demand for the environmental pollution monitoring and control systems. In the view of the ever-increasing pollution sources with toxic chemicals, these systems should have the facilities to detect and quantify the sources rapidly. Toxic gases are one that causes serious health impacts, but are also used in industries in large quantities. These gases have to be monitored; such that increase in the normal level of them could be known and proper precaution measures can be taken. But the current systems available are not so portable and are costly and difficult to implement. Hazardous gases refer to all kinds of gas that can be potential harmful to humans in certain concentrations. The major harmful gases such as CO2, NO2, SO2, CO that evolve from the drainage not only effect the environment but also the natural habitat. The various impacts are environmental impacts, human health impacts and economic impacts. The environmental impacts include, Overall average annual temperatures are expected to increase and Global warming will decrease snow, sea ice and glacier coverage, resulting in rising sea levels and increased coastal flooding.

B. EFFECTS OF TOXIC GAS:

City municipal sewer is one of the city's critical infrastructure, due to it is relatively closed, environment specific, easy to produce large amounts of toxic, hazardous, flammable and explosive gases. If it is in poor management, when hazardous gas leak, there is likely to cause gas accumulation, at last, fire or explosion occurred. In recent years, Chongqing, Nanjing, Wuhan and other places have occurred such serious explosion of City municipal sewer. Sanitation workers suffered gas poisoning incidents have also occurred; It is harmful to people's personal and property safety seriously. With the development of city size and people to enhance environmental awareness, concerns and input of municipal government and community in on-site of the environment is growing, the establishment of an effective monitoring and warning system of municipal sewer is not only an important part of the urban environment, but also imperative requirement of modernization of municipal facilities. Using GPS wireless communication technology, combined with high-performance infrared gas sensor, to design the program for the signal send back to the remote monitoring centre based on the signal processing system and wireless network sensors, the monitoring centres in different position use GPS technology to monitor the municipal sewer pipe to achieve continuous and automatic monitoring for sewer combustible gas in all-weather and alert the users.

II. BASIC WORKING PRINCIPLE

A. TOXIC GAS DETECTION

The toxic gases like carbon monoxide, methane, hydrogen sulphide which is emitted from the drainage wastes. While cleaning the drainage these gases are emitted. The emitted gases are inhaled by the workers in drainage cleaning and it causes a major health effects. The effects like skin allergies, nervous system blockage, aphysixation etc. These toxic gases which give these effects based on their concentration in drainage wastes. If the gas concentration are more than the threshold value it may cause to death also. Hence these gases are sensed by the different sensors and it should be given to the microcontroller to alert the workers by alarm indication. If the sensor value is greater than the threshold value the microcontroller gives the signal to alarm to indicate the warning to labours. This system will help to keep the workers from the effect of toxic gases.

B. GAS DETECTOR

A gas detector is a device that detects the presence of gases in an area, often as part of a safety system. This type of equipment is used to detect a gas leak and interface with a control system so a process can be automatically shut down. A gas detector can sound an alarm to operators in the area where the leak is occurring, giving them the opportunity to

leave. This type of device is important because there are many gases that can be harmful to organic life, such as humans or animals. 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. Gas leak detection is the process of identifying potentially hazardous gas leaks by sensors. These sensors usually employ an audible alarm to alert people when a dangerous gas has been detected. Common sensors include infrared point sensors, ultrasonic sensors, electrochemical gas sensors, and semiconductor sensors.

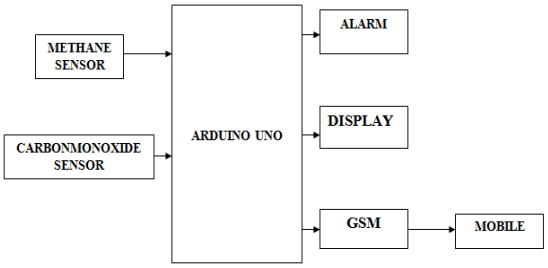

Figure 1. Basic block diagram

III. HARDWARE DESIGN

The toxic gas detection part includes the different hardware setup in it. It consists of arduino setup, methane sensor, carbon monoxide sensor, LCD display, alarm and it can be shown in Figure no.1. The system includes the toxic gas sensors like carbon monoxide and methane. These sensors sense the gases while cleaning the drainage. The sensed values are given to the analog ports of microcontroller which is placed in the arduino board. The microcontroller compares the sensor value to the threshold value of each sensor which is programmed in the microcontroller. If the sensor value exceeds the threshold value the microcontrollers sends the signal to the alarm also sends the message to base station through GPS module and display the value in the LCD display. This will alert the workers to get out from the place.

A. Methane sensor

Methane is commonly generated when organic matter is decomposed by a variety of bacterial processes. It is a colourless, extremely flammable and explosive gas that can cause fire and explosion. The accumulation of methane in a poorly ventilated area will displace normal air and result in an oxygen deficient environment. The methane gas can be sensed by the MQ 4 type sensor. Sensitive material of MQ-4 gas sensor is SnO2, which with lower conductivity in clean air. When the target combustible gas exist, The sensor's conductivity is more higher along with the gas concentration rising. Please use simple electro circuit, convert change of conductivity to correspond output signal of gas concentration.MQ-4 gas sensor has high sensivity to Methane, also to Propane and Butane. The sensor could be used to detect different combustible gas, especially Methane; it is with low cost and suitable for different application. Its characteristics include good sensitivity to Combustible gas in wide range, high sensitivity to natural gas, long life and low cost, simple drive circuit.

B. Carbon Monoxide sensor

The lethal colourless and odourless gas – carbon monoxide, is given off when charcoal is burnt in poorly ventilated areas. Similarly, it is produced when gasoline/diesel generators or other fuel-driven tools are used in inadequately ventilated workplaces. Exposure to carbon monoxide at concentrations over350 ppm can cause confusion, fainting on exertion and collapse. An airborne concentration of carbon monoxide above 1,200 ppm is immediately dangerous to life or health.This sensor which belongs to the type MQ-7 . Sensitive material of MQ-7gas sensor is SnO2, which with lower conductivity in clean air. It make detection by method of cycle high and low temperature, and detect CO at low temperature(heated by 1.5V).The sensor's conductivity gets higher along with the CO gas concentration rising. At high temperature (heated by 5.0V),it cleans the other gases adsorbed at low temperature. Users can convert the change of conductivity to correspond output signal of gas concentration through a simple circuit. It has good sensitivity to carbon monoxide in wide range, and has advantages such as long lifespan, low cost and simple drive circuit &etc. It is widely used in domestic CO gas leakage alarm, industrial CO gas alarm and portable CO gas detector.

C. Arduino Uno

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures kits for building digital devices and interactive objects that can sense and control the physical world. Arduino boards may be purchased preassembled, or as kits; at the same time, the hardware design information is available for those who would like to assemble an Arduino from scratch. The project is based on a family of microcontroller board designs manufactured primarily by Smart Projects in Italy, and also by several other vendors, using various 8-bit Atmel AVR microcontrollers or 32-bit Atmel ARM processors. These systems provide sets of digital and analog I/O pins that can be interfaced to various extension boards and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For Programming the microcontrollers, the Arduino platform provides an integrated development environment (IDE) based on the Processing project, includes support for C and C++ programming languages. Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board. It can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can communicate with software running on your computer (e.g. Flash, Processing and MaxMSP). The boards can be assembled by hand or purchased pre-assembled; the open-source IDE can be downloaded for free.

D. Arduino Uno microcontroller

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of arduino, moving forward. The Uno is the latest in a series of USB arduino boards, and the reference model for the arduino platform. The arduino Uno microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller. Simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip

E. GSM

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz It is estimated that many countries outside of Europe will join the GSM partnership. Throughout the evolution of cellular telecommunications, various systems have been developed without the benefit of standardized specifications. This presented many problems directly related to compatibility, especially with the development of digital radio technology. The GSM standard is intended to address these problems. From 1982 to 1985 discussions were held to decide between building an analog or digital system. After multiple field tests, a digital system was adopted for GSM.The next task was to decide between a narrow or broadband solution. In May 1987, the narrowband time division multiple access (TDMA)solution was chosen. GSM provides recommendations, not requirements. The GSM specifications define the functions and interface requirements in detail but do not address the hardware. The reason for this is to limit the designers as little as possible but still to make it possible for the operators to buy equipment from different suppliers. The GSM network is divided into three major systems: the switching system (SS), the base station system (BSS), and the operation and support system (OSS).

F. LCD display

LCD display is an inevitable part in almost all embedded projects and this article is about interfacing 16×2 LCD with microcontroller. Many guys find it hard to interface LCD module with the but the fact is that if you learn it properly, its a very easy job and by knowing it you can easily design embedded projects like digital voltmeter / ammeter, digital clock, home automation displays, status indicator display, digital code locks, digital speedometer/ odometer, display for music players etc etc. Thoroughly going through this article will make you able to display any text (including the extended characters) on any part of the 16×2 display screen. In order to understand the interfacing first you have to know about the 16×2 LCD module. This module is a very common type of LCD module that is used in 8051 based embedded projects. It consists of 16 rows and 2 columns of 5×7 or 5×8 LCD dot matrices. It is available in a 16 pin package with back light ,contrast adjustment function and each dot matrix has 5×8 dot resolution.

G. Threshold value

GAS	CHARACTERSTICS	MAXIMUM RANGE(ppm)	EFFECT
CH4	Colourless, odourless	>1200	DEATH
CO	Colourless, explosive	>1200	DEATH

Figure 2. Maximum Range Value

GAS	THRESHOLD VALUE GIVEN	OUTPUT VOLTAGE(v)
CH4	700	2.5 to 4.5
CO	400	2.8 to 5

Figure 3. Threshold Value

IV. SOFTWARE USED

Arduino integrated development environment (IDE) is a cross-platform application written in java, and derives from the IDE for the processing programming language and the wiring projects. it is designed to introduce programming to artists and other newcomers unfamiliar with software development. it includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. a program or code written for arduino is called a "sketch".Arduino programs are written in c or c++. The arduino IDE comes with a software library called "wiring" from the original wiring project, which makes many common input/output operations much easier. Most arduino boards contain a led and a load resistor connected between the pin 13 and ground, which is a convenient feature for many simple tests.[1] the previous code would not be seen by a standard c++ compiler as a valid program, so when the user clicks the "upload to i/o board" button in the IDE, a copy of the code is written to a temporary file with an extra include header at the top and a very simple main() function at the bottom, to make it a valid c++ program. Arduino is open-source hardware: the arduino hardware reference designs are distributed under a Creative Commons Attribution Share-Alike 2.5 license and are available on the arduino Web site. Layout and production files for some versions of the arduino hardware are also available. The source code for the IDE is available and released under the GNU General Public License, version 2. Although the hardware and software designs are freely available under copy left licenses, the developers have requested that the name "arduino" be exclusive to the official product and not be used for derivative works without permission. The official policy document on the use of the arduino name emphasizes that the project is open to

incorporating work by others into the official product. Several Arduino-compatible products commercially released have avoided the "Arduino" name by using "-duino" name variants.

V. RESULTS AND DISCUSSION

In this project I successfully completed the design of the toxic gas detection .The methane sensor was sensed the gas. The carbon monoxide sensor was successfully sensed the gas .when detecting the gas by the sensor and its value was exceeded from the threshold value the alarm was indicated and it alerted successfully. When the threshold value is reached the warning message was sent successfully to the base station. The value of the sensor was displayed successfully in the LCD display. The arduino board was interfaced with the sensors and LCD display successfully. In the arduino the microcontrollers was successfully programmed for alarm indication, getting input from sensors and print the values. Hence the system was successfully designed and implemented and results were checked.

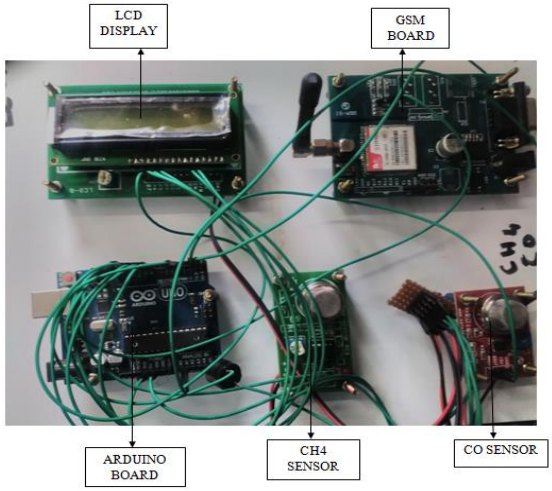

Figure 4. Overall Setup Diagram

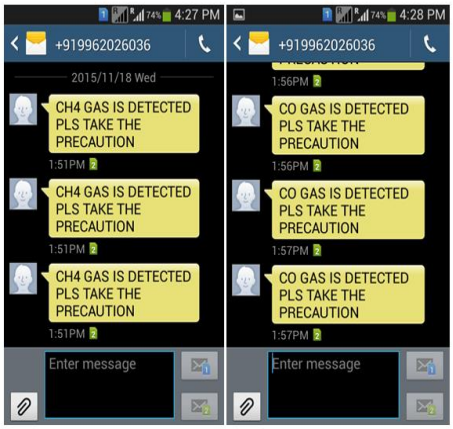

Figure 5. Mobile Output

VI. CONCLUSION

The above system helps the workers in drainage cleaning from the effect of toxic gases. The gases which can be sensed by the sensors. The sensor signal sends to the microcontroller through input ports and it should take the action by warning through the alarm indication and also sends the warning message to the registered mobile number. The signal which alert the users to make sufficient emergency actions and also get out the workers from the drainage. Hence this system will helps the labors in the sufficient manner and it protect from the deaths and reduce the manpower in drainage cleaning.

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