Smart Sewage Alert System For Workers In Real-Time Applications Using Iot

M. Lizzy Nesa Bagyam, B. Raja Nithya, D. Rubikumar, S.Sangeetha , J.Santhosh

Abstract: Sewage treatment is an important environmental protect problem. If the drainage system is not maintained properly, the pure water get mixed with drainage water and cause infectious disease. It is very important that underground drainage system should work in a proper manner to keep the city clean, safe and healthy. At present, the toxicity of gases in sewage cannot be monitored. So various kind of work has been done to detect, maintain and manage these underground systems. To create a barrier to this problem, a hardware model is designed to monitor the sewage system. In this paper, it is discussed about the method to measure the water level in sewage continuously using the ultrasonic sensor. The toxicity of CO and methane gases are also sensed to avoid danger for human life.

Key words: Carbon mono-oxide sensor, GSM, IoT, Methane gas sensor, Sewage monitoring, Ultrasonic sensor, Microcontroller

I.INTRODUCTION

Sanitation workers continue to lose their lives due to the inhalation of toxic gases inside the drainage. Also, leaks and bursts are unavoidable aspects that account for significant loss if left undetected for long period. This proves inadequacy of proper drainage monitoring system. It is very important that drainage system should work in a proper manner to keep the city clean, safe and healthy. So different kind of work has been done to detect, maintain and manage this drainage system. The objective of this system is to obtain an effective low-cost and flexible solution for checking water level and sensing the toxicity of gas and updating it in real time through IoT. In this system, level of drainage is continuously monitored. It also senses the toxicity of gas, as well as sending automatic SMS, if the toxicity of the gas measured is above an expected normal range. Since the output of level and gas sensors are interfaced with microcontroller, it checks the threshold level and sends an alert message through GSM and monitored using IoT. The main advantage of this system is to avoid deaths due to exposure of harmful sewage gas.In this paper [1], level sensor is used to detect the water level in the drainage. It also displays the level. It does not detect the level continuously. If the water level in drainage exceeds above the normal range, it causes leakage and affects the environment. Sensor is used to detect the clog [2].

When the drain is clogged, water will have a difficult time passing through the time, causing drainage to be slower than usual. Often times, more severe clogs will even cause water to travel back up to drain and bubble up. In the existing method, sensor is used to detect the flow rate. It also displays the flowrate. As a result of rain, flow rates are high than the daily averages [3].To overcome the above drawbacks, the proposed system uses level and gas sensor with WEMOS D1. In this method, a sensor node containing two gas sensors and a level sensor that transfers the appropriate sensed information about the harmful gases and water levels of drainage system. The WEMOS D1 checks for the specific conditions and it sends automatic SMS through GSM and update it in real time through IoT.

II.HARDWARE REQUIRMENTS

2.1 BLOCK DIAGRAM

The block diagram of Smart Sewage Monitoring System is shown in Figure 1.

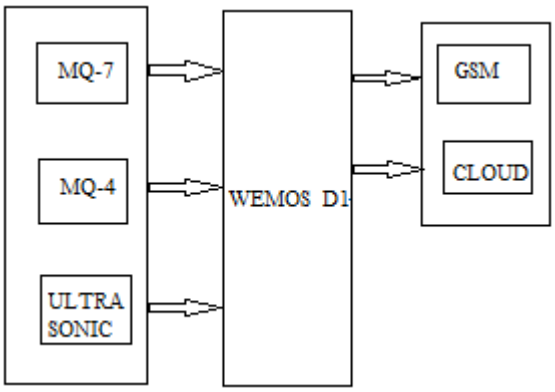

***Figure 1**. Block diagram of Smart Sewage Monitoring System.*

2.2 LEVEL SENSOR

Ultrasonic sensor works by sending sound waves that echo off of a target and return to the transmitter. The receiver mode in the ultrasonic level sensor receives the reflected and converts into an electrical signal [1]. The electrical signal output from the ultrasonic level sensor is amplified and processed to find the reflected echo and then

- *M.Lizzy Nesa Bagyam is currently working as Assitant Professor,*
- *Kongu Enginnering College,TamilNadu,India*
- *B.Raja Nithya is currently pursing bachelor degree programme in Electronics and Instrumentation Engineering College,Tamilnadu,India.*
- *D.RubiKumar is currently pursing bachelor degree programme in Electronics and Instrumentation Engineering College,Tamilnadu,India.*
- *S.Sangeetha is currently pursing bachelor degree programme in Electronics and Instrumentation Engineering College,Tamilnadu,India.*
- *J.Santhosh is currently pursing bachelor degree programme in Electronics and Instrumentation Engineering College,Tamilnadu,India.*

calculated to find the distance to a specific target.The distance to an object is calculated and then converted by the ultrasonic level sensor to 4-20 mA signal. The Figure 2. shows the Ultrasonic level sensor.

Figure 2. *Ultrasonic level sensor*

The specifications of ultrasonic sensor are,

- Working Current: 15mA
- Resolution : 0.3 cm
- Measuring Angle: 30 degree
- Trigger Input Pulse width: 10Us
- Dimension: 45mm x 20mm x 15mm.

2.3 METHANE GAS SENSOR

The methane gas sensor detects the concentration of methane gas in the air and output is an analog voltage [4]. The concentration of sensing range is about 300 ppm to 10,000 ppm The sensitivity of the detector is set by a resistive load between the output pins and ground. The sensor's conductivity increases when the gas concentration gets increases. MQ-4 gas sensor has high sensitivity to methane. The Figure 3. Shows the Methane gas sensor.

Figure 3. *Methane gas sensor*

The specifications of methane gas sensor are,

- Supply voltage: 5 V
- Load resistance: 20Kohm
- Operating temperature: 10°C-50°C
- Sensing resistance: 0KΩ- 60KΩ

2.4 CO GAS SENSOR

A carbon mono-oxide or MQ-7 sensor is used to measure carbon mono-oxide gas [4].The most common principles for CO sensors are infrared gas sensors and chemical gas sensors. The CO Gas Sensor measures gaseous carbon mono-oxide in two ranges 0 to 10,000 ppm and 0 to 100,000 ppm The Figure 4. shows the CO gas sensor.

Figure 4. *CO gas sensor*

The specifications of CO sensor are,

- Supply voltage: 3.3V-5.5V.
- Maximum current: 75mA.
- Response time: 8S.
- Repeatability: 10ppm.

2.5 ADC

An analog-to-digital converter is a system that converts an analog signal, such as output signal from the sensor, into a digital signal. An ADC is an electronic device that converts an input analog voltage or current to a digital number representing the magnitude of the voltage or current. It may also provide an isolated measurement. Typically the digital output of ADC is a two's complement binary number that is propositional to the output, but there are other possibilities [5]. The following table 1. shows the specifications of ADC.

Table 1. *Specifications of ADC*

S.NO	*FEATURES*	*RANGE*
1	*Channel*	*6*
2	*Bit Resolution*	*10*
3	*Frequency*	*50kHz to 200kHz*

2.6 WEMOS D1

The WEMOS D1 is an ESP8266 Wi-Fi based board that uses the Arduino layout. It has 11 digital input/output pins, 1 analog input, 80MHz/ 160MHz, 4M bytes flash, a power jack, 7-12V power input, a Micro USB connection, compatible with Micro Python, Arduino, Node MCU. It's operating voltage is 3.3V [4].The Figure 5. shows WEMOS D1.

Figure 5. *WEMOS D1 board.*

2.7 ESP8266 Microcontroller

The ESP8266 microcontroller is a modified architecture 32-bit RISC single-chip microcontroller. The ESP8266 is a 1 MB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi. ESP8266 controller program and data are stored in separate physical memory systems that appear in different address spaces, but having the ability to read data items from program memory using special instructions. ESP8266 controller delivers ease of use, high performance, low power consumption S and high level of integration [4].

2.8 GSM MODULE

A GSM module could be a chip or circuit that will be used to establish communication between a mobile device and a computing machine. It describes the protocols for second generation digital cellular networks used by mobile phones. It's the default world customary for mobile communications. GSM system was developed as a digital system using time division multiple access technique for communication purpose. A GSM digitizes and reduces the information. It sends the data down through a channel with two different streams of client data, each in its own particular time slot [6]. The digital system can carry 64 kbps to 120 Mbps of data rates.

The specifications of GSM module are,

- Supply voltage: 4.5V-5.5V.
- Current consumption: 500 mA.
- Operating temperature: -40 C to 85 C.

2.9 INTERNET OF THINGS

The internet of things is a system of associated computing devices and machine that are give withs identifiers. It has the ability to transfer data over a network without requiring human intervention. The embedded processors, sensors and communication hardware are used by web-enabled smart devices to collect, send and perform on data they achieve from their environments. IoT devices share the sensor data they collect by connecting either with IoT gateway or with other edge device where data is either sent to the cloud to be analysed locally. Further, these devices communicate with other related devices and act on the information they get from one another. The mechanism work without human interruption, although people can combine with the devices for instance, to set them up, give them instructions or access the data [6].

III.WORKING METHODOLOGY

A sensor node containing two gas sensors and a level sensor that transfers the appropriate sensed information about the harmful gases and water levels of drainage system. The MQ-7 sensor and MQ-4 sensor sense the toxicity of CO and methane. The ultrasonic sensor used here acts as a level sensor that continuously sense the waste water level in the sewage [4]. The Figure 6. shows the circuit diagram of input block.

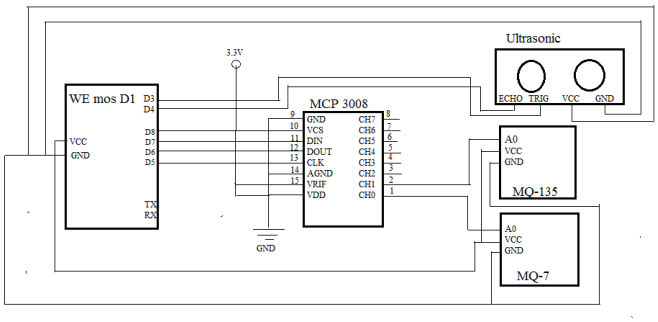

Figure 6. *Circuit diagram of input block.*

The trig and echo pins of level sensor is connected to digital pin 3 and digital pin 4 in the WEMOS D1. The VCC and GND pin of the level sensor were connected to +5V and GND pin of WEMOS D1. The two analog inputs of gas sensors MQ-7 and MQ-4 connected to WEMOS D1 through an ADC (MCP3008). The channel 0 and channel 1 of ADC were connected to the A0 of both the gas sensors. The analog pins A0 of both gas sensors were connected to channel 0 and channel 1 of ADC (MCP3008). The pins D5, D6, D7, D8 of WEMOS D1 were connected to CLOCK, DIN, DOUT and CS pins of MCP3008. The trigger and echo pins of level sensor connected to D3 and D4 pins of WEMOS D1. The +5V of level sensor is connected to VCC and GND pin is connected to GND pin of WEMOS D1. The Figure 7. shows the circuit diagram of output block.

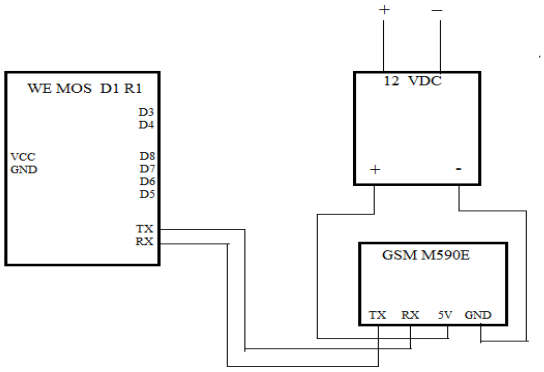

Figure 7. *Circuit diagram of output block.*

The TX and RX pin of the GSM M590E module were connected to the RX and TX pin of the WEMOS D1. The VCC and the GND pin of the GSM M590E module were connected to +5VDC of a bug converter. The RX and TX pins of GSM M590E is connected to TX and RX pins of the WEMOS D1. Then the VCC and GND pins of GSM is connected to the input

supply for GSM is taken from the +5V output of bug converter. Using the communication modules this data will be transmit to the cloud (server). The controller keeps a check in the level of water with the help of level sensor if the level increases it is seen from the base station and cleared by the workers. The gas sensors used to measure the toxicity of various hazardous gases and if the toxicity increases beyond the threshold value, an alert message will be sent to base station by which drainage workers can take precautions while entering in manholes.

IV.HARDWARE SETUP

The hardware setup of Smart Sewage Monitoring System is given in Figure 8.

Figure 8. *Hardware setup of Smart Sewage Monitoring System.*

V.CONCLUSION

Level measurement using ultrasonic level sensor helps in the real time measurement. Ultrasonic waves are used to measure level of sewage water. This hardware was developed to monitor the threshold of gases by interfacing the level sensor and gas sensors with WEMOS D1 in order to save the life of sanitation cleaner from the exposure of harmful gases. Further, this method can be extended in future to remove the gases produced inside the drainage whose toxicity increases beyond safety limit.

REFERENCES

[1] P. M. Berthouex, W. G. Hunter, L. Pallesen (2018), “Monitoring sewage treatment plants: some quality control aspects”, Journal of Quality Technology, vol.10, pp. 139-149.

[2] M. J. Gomez, M. J. Martinez Bueno, S.Lacorte (2007), “Pilot survey monitoring pharmaceuticals and related compounds in a sewage treatment plant”, ELSEVIER- Chemosphere, vol. 66, issue 6, pp. 993-1002.

[3] Wilfrid Bourgeois, Joanna E Burguess, Richard M Stuetz (2001), “On-line monitoring of wastewater quality”, Journal of Chemical Technology and Biotechnology, vol. 76, issue 4, pp. 337-348.

[4] K.Keshamoni, S.Hemanth (2017), “Smart gas level monitoring gas leakage detector over IoT”, IEEE 7th International Advance Computing Conference (IACC), pp. 330-332.

[5] N. Duro, Elena Gaudioso, Raquel Dormido (2019) “Machine learning weather soft-sensor for advanced control of wastewater treatment plants”, Article in Sensors 19(14):3139.

[6] X. Li, R. Lu, X. Liang, X. Shen, J. Chen, X. Lin (2011), “Smart Community: An Internet of Things Application”, IEEE Communications Magazine, vol. 49, pp. 68-75.

[7] Kathryn Newhart, Amanda S. Hering, Ryan Holloway, Tzahi Cath(2019), “Data-driven performance analyses of wastewater treatment plants”, Article in Water research 157.

[8] R.Rushikesh, C.M.R Sivappagari (2015), “Development of IoT based vehic-ular pollution monitoring system”, International Conference on Green Com-puting and Internet of Things (ICGCIoT), pp. 779-783.

[9] P. M. Ramos, J. M. D. Pereira, H. M. G. Ramos, A. L. Ribeiro(2008), “A four terminal water quality monitoring conductivity sensor”, IEEE Transactions on Instrumentation and Measurement, vol. 57, no. 3, pp. 577-583.

[10] Z. Hu, Z. Bai, K. Bian, T. Wang, L. Song (2018), “Real-time fine-grained air quality sensing networks in smart city: Design implementation and optimization”, CORR, vol. 49, pp. 53-71.