Automatic Drainage Monitoring and Alert System Using IoT

K. R. Chairma Lakshmi, B. Praveena, K. Vijayanand, and S. Vijayalakshmi

Abstract The implementation of smart technology is used to improve the safety and efficiency in the drainage monitoring system, which decreases the need of man power and transport costs. The proposed system which accentuates on “SMART CITIES” is used to implement a smarter way of sewage management using smart sensors connected through IoT. The objective of this scheme is to develop a smarter way of conventional drainage monitoring system using smart sensors and IoT. Another key intention is to prevent gas poisoning in sewage maintenance work which can be deadly. An alert system is to be established which constantly monitors the flow, level and toxic gas amount of the sewage pipeline. The status of the particular drainage route is constantly monitored and displayed on the webpage. If any possibility of overflow is detected, the sewage is pumped to the alternate drain automatically until manual maintenance can be performed.

Keywords Sanitized workers safety · Flow sensor · IoT · Level sensor · Toxic gas sensor

1 Introduction

Drainage system plays a vital role in the metropolitan cities. One of the most critical issues of the recent times is the absence of proper sewage monitoring system. Monitoring of drainage status like overflowing of waste water in drainage, toxic gas present in drainage, etc., is not possible manually. Regardless of how well built a city’s architecture is the sewage system still proves to be poorly maintained. The most important priorities are to ensure a clean and healthy globe and to protect the urban environment. Drainage monitoring is a crucial task and a tedious one since the location of the leakage cannot be identified easily. The problem arising in such drainage lines like blockage due to waste solid and liquid, rapid rise in the water level as well as various harmful gases will be unavoidable if the appropriate cleaning actions are

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not taken from time to time can root serious problems to the everyday routing of the city. The absence of efficient drainage management has caused serious environmental problems and cost issues. In the existing methods, IoT is used for various applications or fields like health monitoring, industrial automation, agriculture, transference, military, logistics, environmental and security purpose [1–5]. A long-term drain monitoring system designed using a variety of sensors, including water level sensor, blockage, and gas sensor. The flood can be classified as low, medium, or high depending on the water level sensor. This can help with flood detection in the early stages [6–10]. The gas sensors are designed to detect a variety of harmful gases so that drain workers may take measures when entering manholes [11–18]. Similarly, wireless sensor networks with flow and level sensor unit also used for monitoring the drainage. The drawback of the existing systems is even through drainage level and gas monitoring by system but it not providing intimation to works about location of the drainage, Cost of WSN is too high [19–21].

The aim of this proposed method is to present a smart drainage management system with help of Internet of Things and intelligent sensors to constantly monitor the drains in urban areas. Ultrasonic sensor is used to detect the level of the drainage. Similarly, a Hall Effect type flow metre is used to constantly measure the flow of drainage. Gas sensor is used to detect the presents of harmful gases like hydrogen sulphide, methane in the drainage. These sensors are connected to the internet through a Wi-Fi module and their status can be monitored using the webpage. The webpage is developed using PHP and HTML 5. The collected data are stored in MySql database.

2 Materials and Method

2.1 Proposed Methodology

The Photographic image and block diagram of proposed model are shown in Figs. 1 and 2, respectively. This arrangement provides an automatic mechanism to constantly monitor the drainage lines for various parameters such as drain level, flow rate of the sewage and the presence of various kinds of toxic gases. These sensors are intelligently connected to Internet of things through a sensor network. The various values of the sensors are constantly updated in every moment of time in an exclusively created IoT webpage. This webpage has a unique login page in which the respective municipality departments can login and view the status. New users can also create a login membership.

Fig. 1 Photographic image of the prototype

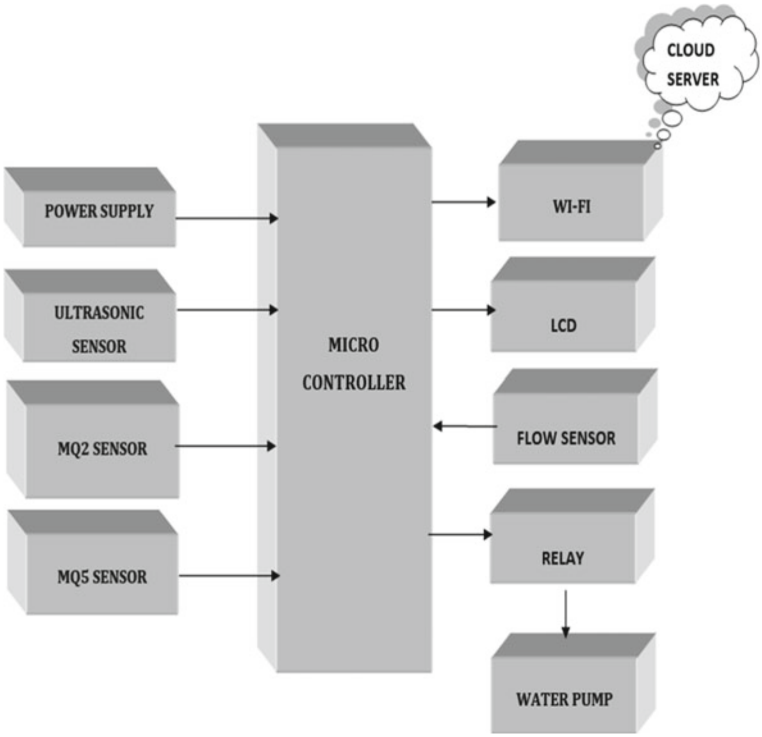

Fig. 2 Block diagram of the hardware section

2.2 Flow Chart of Proposed Methodology

Figure 3 shows the flow chart of proposed system. In case, the level of the drainage increases beyond the threshold limit an alert is immediately displayed on LCD display screen. Simultaneously, the sewage water is pumped to the next drain to prevent overflowing for a brief period of time until manual assistance can be deployed. In the webpage, each drain has the previous history of the particular route for future references. Along with that location of every particular drain is also prefixed, which enables the sanitation workers to identify the blockage easily.

3 Result and Analysis

The status of the drainage is constantly monitored using an IoT webpage. The webpage consists of an initial signup page in which the first-time users are required

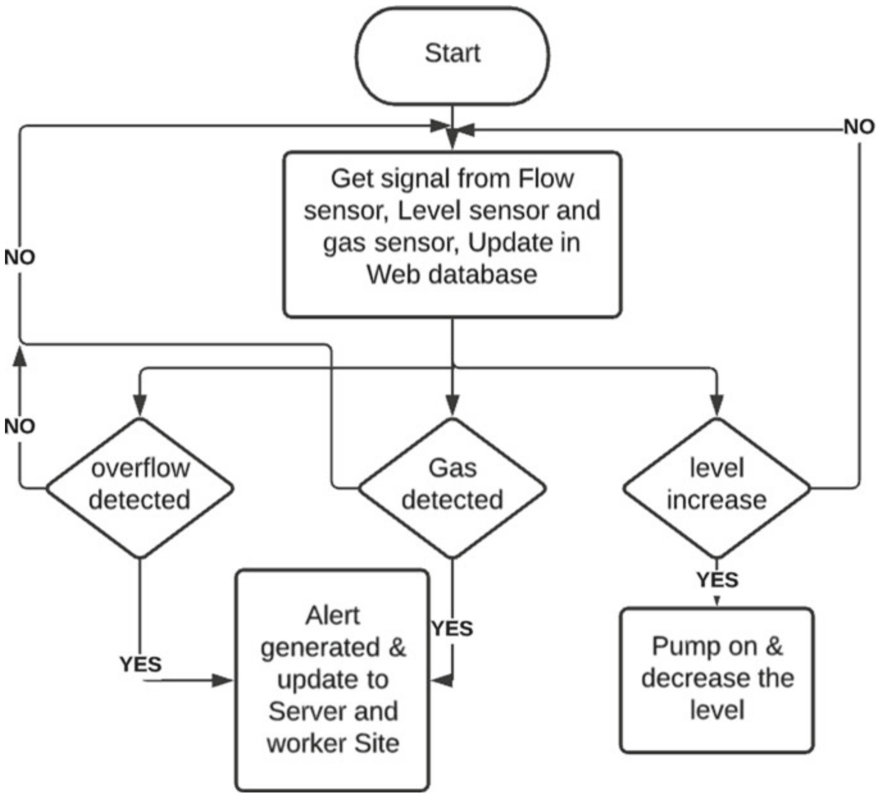

Fig. 3 Flow chart of the proposed system

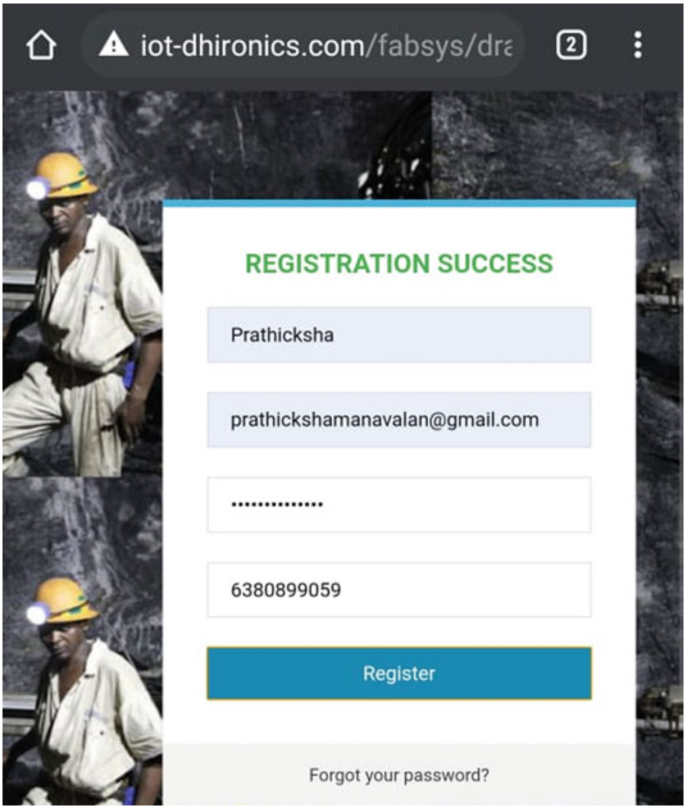

Fig. 4 User authentication

to create an account as shown in Fig. 4. Once the login credentials are generated, the concerned urban municipality departments can check the status. Once in, a series of drain routed are collectively visible in the following webpage, all of which status are constantly monitored as shown in Fig. 5. Each drainage monitoring webpage has various attributes which displays flow rate, total volume in litre, toxic gas levels and level status along with time stamp as shown in Fig. 6. By the use of MySQL RDBMS, the previous history of each drainage is also stored for future reference unless reset. The location of each drain is also visible in the Google map which helps in easy identification of blockage. In case any overflow occurs, an alert is shown in the LCD Screen as shown in Fig. 11.

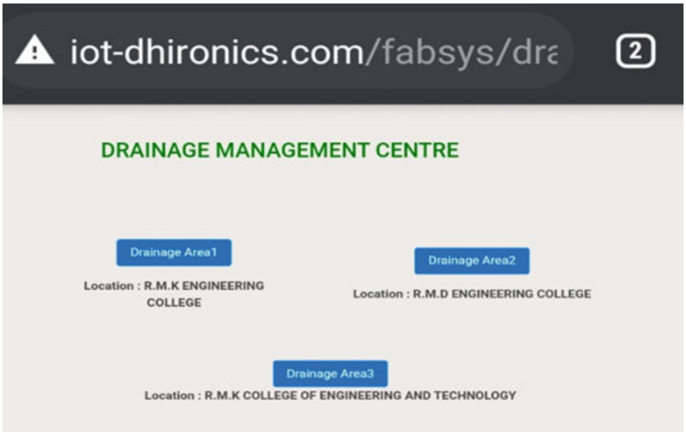

Fig. 5 Drainage selection webpage

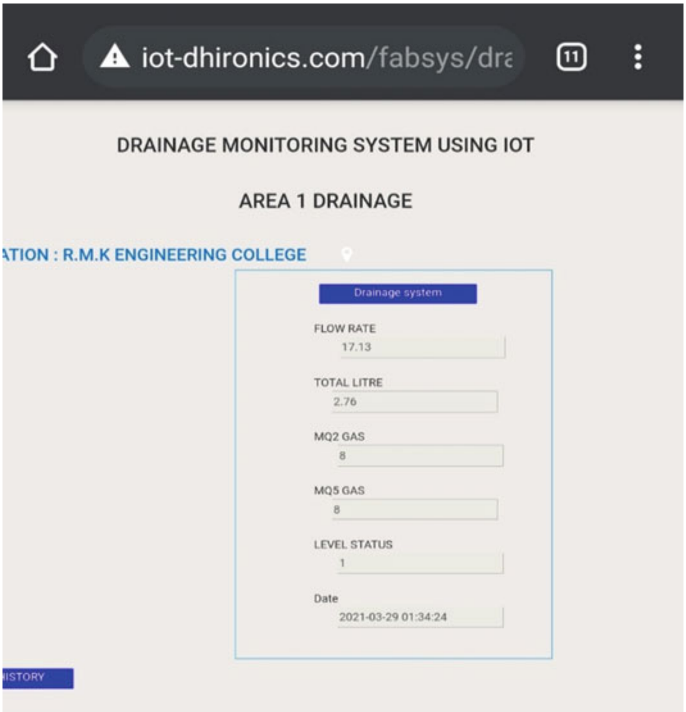

Fig. 6 Output indication in IoT page for case 1

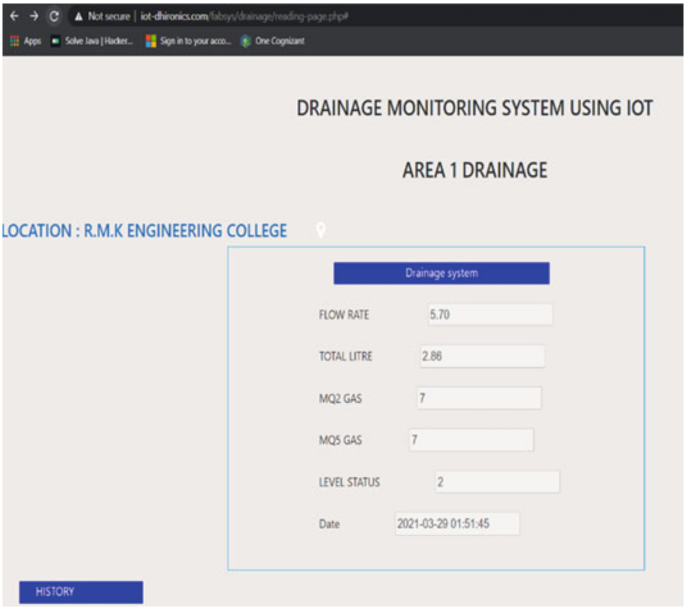

Fig. 7 Output indication in IoT page for case 2

3.1 Case 1: Drainage Status 1

If the drainage Level filled 75–100%, then it is indicated as level status = 1 in IoT page as well as the total litres of water present in the drainage along with the toxic gases is updated in the IoT webpage which is shown in Fig. 6.

3.2 Case 2: Drainage Status 2

In case 2, drainage water Level 50–75% filled which is indicated as level status = 2, toxic gas along with the flow rate is updated in the webpage as shown in Fig. 7.

3.3 Case 3: Drainage Status 3

In case 3, drainage water Level 25–50% filled which is indicated as level status = 3, the flow rate differs based on the litres present in the drainage and the toxic gas is detected and updated in the webpage as shown in Fig. 8.

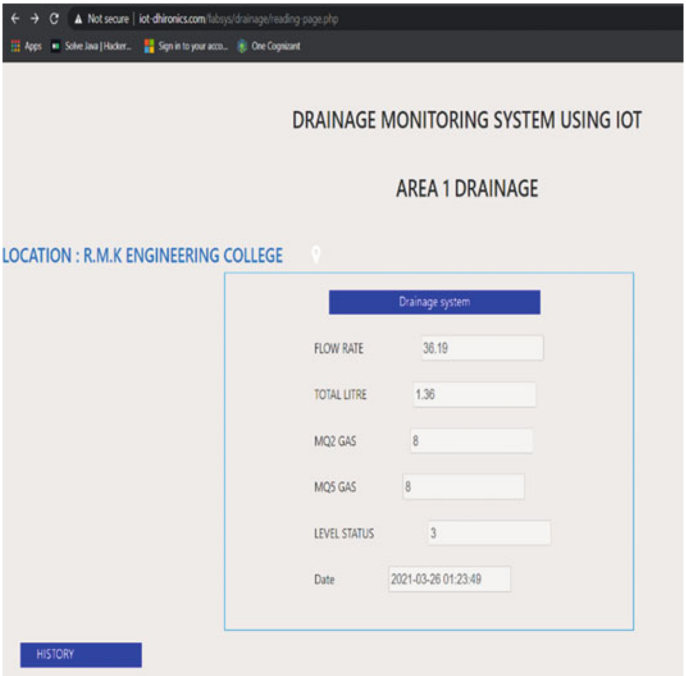

Fig. 8 Output indication in IoT page for case 3

3.4 *Case 4: Drainage Status 4*

In case 4, water Level 0–25% filled which is indicated as level status = 4 in IoT page which is shown in Fig. 9 and this case tested only for toxic gas and the water level condition and it's updated in the IoT webpage (Figs. 10 and 11).

When an overflow is detected, the connected pump starts to pump the sewage water to the next drain for a pre-mentioned brief period of time, until manual assistance can be deployed. This prevents any unwanted leakage that may cause public nuisance and accidents. The toxic gas detection is intimated in the LCD display as shown in Fig. 12.

If overflow or toxic gas detected, then the location of particular drainage is informed to the sanitation worker through message as well as the shortest path also shared with them using the map icon in IoT webpage. If the icon is selected, it will direct sanitation workers to the Google maps which provide optimal path to reach the affected area quickly.

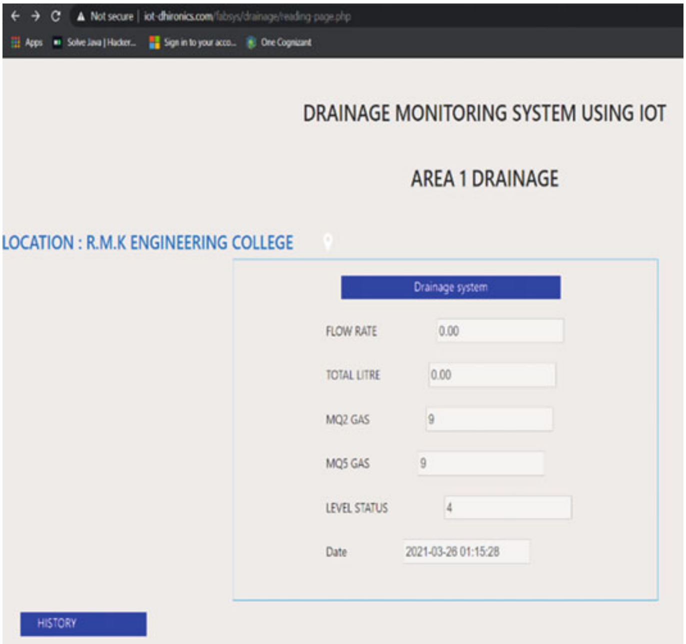

Fig. 9 Output indication in IoT page for case 4

4 Conclusion

The goal of our proposed system is to develop a safe and healthy environment by modernizing a smart drainage monitoring system with help of IoT applications for metropolitan cities. The real-time situation of the drainage system is monitored by using various sensors like gas sensor, ultrasonic sensor and flow sensor. With the support of smart and people friendly proposed drainage monitoring system, problem in the drainage can be detected early and the alert message or information will be update in IoT page for monitoring purposes. As well as, optimal path between location of blocked drainage and sanitation worker location is indicated using Google map to reach the affected area quickly.


HISTORY TO DRAINAGE MONITORING SYSTEM

RESET

Back

FLOWRATE	TOTALLITRE	MQ2 GAS	MQ5 GAS	LEVEL	DATE & TIME
36.19	1.36	8	8	3	2021-03-26 01:23:49
36.19	1.36	8	8	3	2021-03-26 01:23:49
36.19	1.36	8	8	4	2021-03-26 01:23:48
36.19	1.36	8	8	3	2021-03-26 01:23:48
36.19	1.36	8	8	4	2021-03-26 01:23:48
36.19	1.36	8	8	4	2021-03-26 01:23:48
36.19	1.36	8	8	3	2021-03-26 01:23:48
36.19	1.36	8	8	4	2021-03-26 01:23:47
36.19	1.36	8	8	2	2021-03-26 01:23:47
36.19	1.36	8	8	2	2021-03-26 01:23:47

Fig. 10 Previous history of a drainage route

Fig. 11 Overflow alert on LCD

Fig. 12 Toxic gas alert shown on LCD

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