INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT (IJSREM)
VOLUME: 06 ISSUE: 06 | JUNE - 2022 IMPACT FACTOR: 7.185 ISSN: 2582-3930

Sewage Monitoring of Different Parameters using LoRaWAN Technology

Dr. D.V. Rojatkar, Associate Professor

Sumedh Belkhede*, Rohit Kawade, Abhishek Pathode*****

(Department of Electronic and Telecommunication, Government College of Engineering, Amravati – 444604, Maharashtra, India)

***Abstract*— The sewage system is a critical component of a city, responsible for the accumulation of both rain and grey water from residences and industry. To minimize major interruption, a monitoring system and a plan for previous growth in the sewage management system are required. This project presents a paradigm for an intelligent sewage management system that allows real-time monitoring while retaining the prior system's functionality. The sewerage state functions as an input through the sensors; subsequently, the microcontroller records the value and sends it through the LoRaWAN module, which executes waste collection based on the present scenario**.

***Keywords*—** *LoRaWAN*

I. INTRODUCTION

The deployment of sensor nodes has increased dramatically due to the Internet of Things and M2M connectivity. IoT development is occurring at all phases of industrial and market growth. It specifies the methods for developing, administering, and maintaining networks, data, the cloud, and connections. IoT-enabled devices, sensors, and advanced data analytics may be utilised for a variety of applications including smart parking, security, agricultural farming, e-health and wearables, and many others.

In large cities, the sewage system is extremely important. Even if the globe is fast evolving towards smart cities, the challenges that people encounter are still crude. Current improvements and complexity in planning are quite important in the modern society. Inhalation of hazardous gases located inside the manhole continues to claim the life of sewage employees. This demonstrates that the sewage system is not properly monitored. In this paper, we proposed to design and developing a LoRaWAN-based system to monitor sewage system manhole covers. The sewage system has the instability and uncertainty with the features of multi variable, nonlinear, time variant and random treatment process.

Figure 1- Open Manhole with cover

II. LORAWAN

LoRa is a low-power network technology. This is one of the most recent and long-range technologies based on chirp spread spectrum technology. LoRa is the protocol that was created to specify the network's higher tiers. LoRa is a MAC layer protocol that manages communication between LPWAN gateways and end node devices. LoRaWAN is supported by the LoRa Alliance. A typical LoRaWAN network is made up of end-devices, gateways, and a server that collects and analyses data mined by motes. The network topology is a "star of stars," which implies that groups of motes are linked to gateways through LoRa wireless communications, and the gateways are linked to a distant server via an IP network. The server might be housed in the cloud.

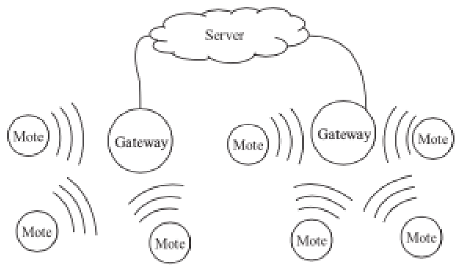

Figure 2- LoRa Topology

VOLUME: 06 ISSUE: 06 | JUNE - 2022 IMPACT FACTOR: 7.185 ISSN: 2582-3930

LoRaWAN motes are classified into three types. Class A devices must provide the fundamental LoRaWAN capabilities. Class A supports bidirectional communication, which is structured as follows. The devices employ unslotted random access, comparable to ALOHA, for uplink transmission. Downlink transmission is only possible during specific time intervals known as receive windows, which follow successful uplink broadcasts. If the network demand is minimal, Class A has the lowest energy consumption for the motes, however even in this scenario, the downlink suffers lengthy delays. Bidirectional communication is implemented in Class B using planned downlink receive slots. The gateway sends out beacons, which disseminate scheduling information. Class C devices continually listen to the channel, resulting in the lowest downlink latency but extremely high power consumption.

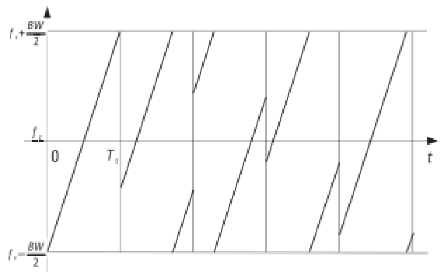

Figure 3- Evolution of signal frequency with time for a LoRa transmitter

III. RELATED WORK

LoRaWAN research and initiatives have been performed for many applications utilised in smart cities and other locations. Green CityZen and the United Nations use LoRaWAN to secure water distribution in African refugee camps. The LoRaWAN initiative seeks to secure 15 camps in Uganda and Ethiopia that house over 2 million refugees. The Green CityZen Business programme controls the sensor fleet, analyses key indications, creates warnings, and assists in making the best decisions and controlling invoicing of their water tank providers. The TTN uses a LoRaWAN network, whilst the French start-up has established a network of 300 Ultrasonic Level sensors together with an IoT platform that continually analyses available water supplies and truck deliveries. The goal of a smart electric metre that uses LoRa is to take electric energy consumption readings on a regular basis and communicate them.

A smart prepaid electric meter equipped with a LoRa module collects and transmits data such as energy power, voltage, and so on to a gateway. The gateway is the central unit that collects all data from all meters and is linked to the local storage device. The data is sent to the cloud through the gateway.

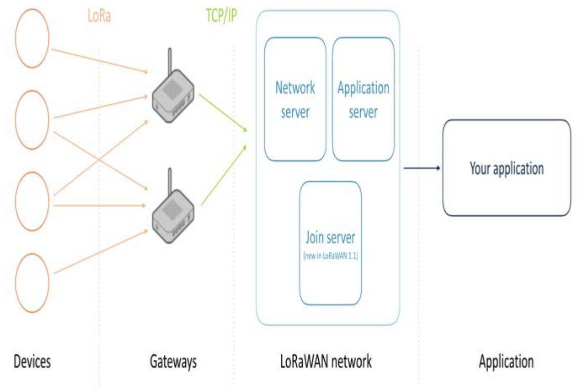

Figure 4- Block diagram of LoRaWAN network

IV. IMPLEMENTATION

We propose in this study to build and construct a LoRaWAN-based system to monitor manhole covers used in sewage systems. Monitoring the health of manhole covers is a difficult topic in poor nations. Manhole coverings are frequently destroyed or stolen as a result of numerous accidents and fatalities. Our device will detect the location and condition of manhole covers.

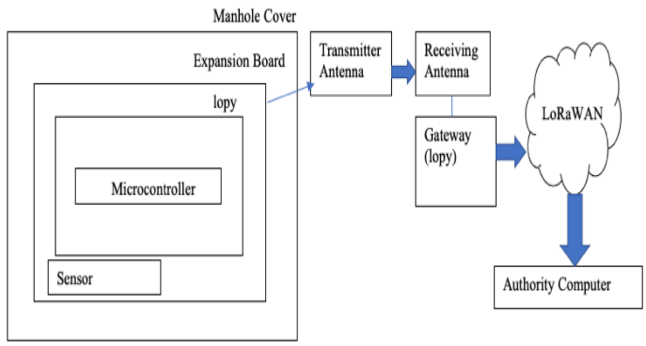

Figure 5- Block schematic of manhole cover monitoring system

We are using LoRa module SX1278 Ra-02 for transmission and reception of signal, Arduino UNO microcontroller, DHT11 temperature sensor and MQ135 Air quality monitoring sensor and 16x2 LCD display for showing the result of the sensor on reception end. LoRa nodes and gateway are programmed and configured by using Arduino IDE. In the manhole cover monitoring system, the module sense the RF signal periodically. When there is the movement of manhole cover and temperature and Air quality changes, it alerts the Arduino board connected there. LoRa board transmit RF signal wirelessly in the unlicensed frequency band for long-distance. This signal is received by nearby LoRa module which is connected to receiving microcontroller. The data will be displayed in 16x2 LCD display, and it will alert the maintenance department for repairing purpose.

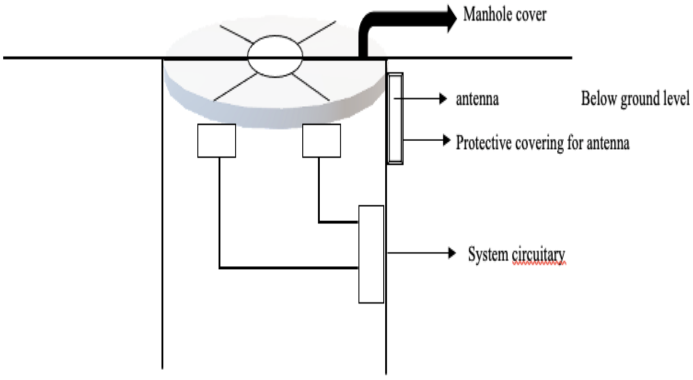

Figure 6- Placement of LoRaWAN module

During the implementation, we have used LoRa nodes When the manhole cover is abnormal, it will display the data on 16x2 LED display to notify the relevant departments to repair and realize the municipal manhole cover's periodical supervision. The proposed placement of the LoRa hardware on the manhole cover is as shown in. The process flowchart for the working is.

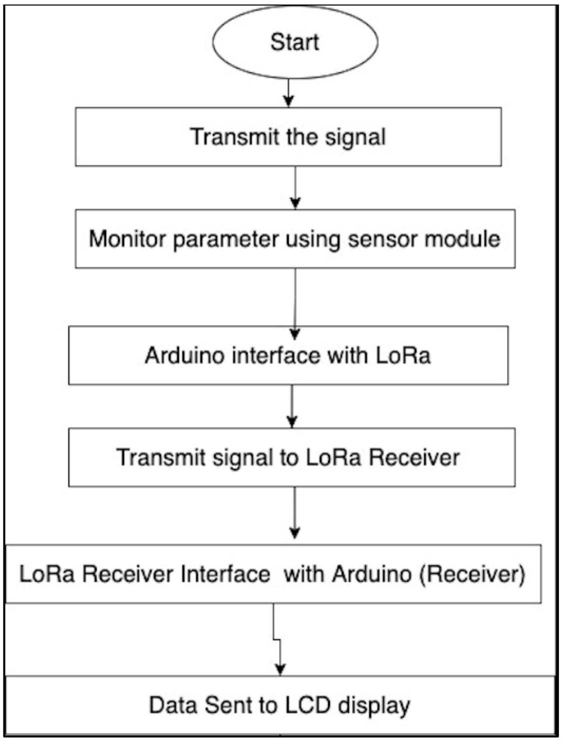

Figure 6- Process Flowchart LoRaWAN module.

It communicates consecutively with the devices like microcontroller, LoRa Module.

V. RESULT

As a result of our work, we identified the benefits of using LoRaWAN as well as other integrated sensors with high accuracy and minimal data loss.

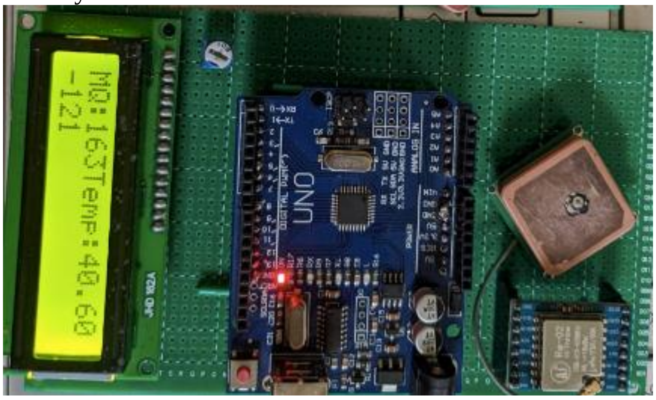

Figure 7-Received Data Values

VI. FUTURE SCOPE

The presented scheme will assist sewage employees in protecting their lives from potentially fatal diseases such as hepatitis and typhoid. According to recent news reports, numerous sewage employees were killed while on the job after coming into contact with significant concentrations of such hazardous vapours, which when inhaled caused major health problems. This modern technology-based IOT system will have a substantial influence on the lives of sewage employees. We may enhance the concept by integrating more sensors for other harmful gases such as sulphur dioxide, hydrogen sulphide (H2S), methane, and so on. Furthermore, by including additional functions like as location services, monitoring, and a changed warning system, this design can serve a significant societal purpose. As a result, the department of health and sanitation will benefit from this initiative.

VII. CONCLUSION

Septic tanks are a means of preventing the dangerous escape of gaseous components into the environment in both residential and industrial regions. When sewage decomposes naturally, it frequently produces harmful fumes. If ingested over an extended length of time, these gases can be harmful and can cause chronic ailments in the workforce if excessive amounts are introduced into the body. Septic tank gases include sulphur dioxide, hydrogen sulphide (H2S), methane, ammonia, nitrogen dioxide, carbon dioxide, and traces of carbon monoxide. As a result, these poisonous fumes become harmful, particularly for sewage workers and cleaners, and can occasionally result in death. As a result, an IOT-based monitoring system was created and designed to avoid exposure to such occupational dangers. In this project carbon monoxide gas was sensed using sensor module MQ-7 and methane gas. These sensor modules detect ppm levels. As the readings obtained lied between analog levels of 0 to 1023, by calibrating the sensors the concentration was converted parts per million (ppm).

IoT-based M2M traffic-oriented applications do not fall into a clearly defined set of criteria, but rather include adaptive and broad ranges of coverage, capacity, bandwidth, cost, and other functional expectations. LPWAN systems have largely been aimed at a subset of these applications, with an emphasis on broad coverage, a large number of low-cost devices, very efficient energy operations, and a comparably restricted bandwidth range. This study has presented a framework for establishing a set of design considerations for designing and assessing an LPWAN technology's appropriateness for its intended use.

We suggest using low-power long-distance LoRaWAN technology to monitor manhole covers. Long-distance transmission with unlicensed band operation is possible with this low-cost and highly secure technology. If a manhole cover is damaged, the system promptly tells the maintenance personnel to take appropriate action. The technology can both prevent accidents and save residents' lives. The technique also enables current technologies to discover gaps and assess the appropriateness of their implementation for the applications for which they are intended. It enables them to create changes and updates that are consistent with the application's properties. This technology has various possibilities for smart cities and other societal improvements.

Previous approaches recommended manual sampling for sewage gas analysis at predetermined time intervals. This did not account for various elements such as water pump condition, gas retention, and facility damage, which periodically affected sewer conditions. Manual charting makes it difficult to record the fluctuation in gas concentration, and it is also hazardous for the engineer installing systems to be exposed to such locations on a regular basis. This is a significant disadvantage that can be solved with internet monitoring. This also collects values that differ from site to site, and this sort of sampling is useful for long-term measurement of gas concentrations over large sewage networks.

ACKNOWLEDGMENT

Dr. D.V. Rojatkar, Dept. of Electronic and Telecommunication, Government College of Engineering, Amravati, has been a source of support and guidance throughout this research. We are also obliged to our Head of Department (Dept. of Information Technology), Dr. P.R. Deshmukh for giving us this great opportunity. We are thankful for their cooperation during the period of our assignment and research.

REFERENCES

[1] Ferran, A.; Vilajosana, A.; Tuset-Peiro, P.; Martinez, B.; Melia-Segui, J.; Watteyne, T. Understanding the limits of LoRaWAN. IEEE Commun. Mag. 2017, 55, 34–40.

[2] 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.

[3] Mekki, K.; Eddy, B.; Frederic, C.; Fernand, M. A comparative study of LPWAN technologies for large-scale IoT deployment. ICT Express 2019, 5, 1–7.

[4] 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.

[5] Chaudhari, Bharat S. and Marco Zennaro, eds. LPWAN Technologies for IoT and M2M Applications. Academic Press, 2020.

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

[7] Zhang He-sheng, Lei Li, and Xuan Liu, Development and test of manhole cover monitoring device using LoRa and accelerometer, IEEE Transactions on Instrumentation and Measurement. vol. 69, no. 5, pp. 2570-2580, 2020.

[8] Adelantado, Ferran, Xavier Vilajosana, Pere Tuset-Peiro, Borja Martinez, Joan Melia-Segui, and Thomas Watteyne. Understanding the limits of LoRaWAN, IEEE Communications magazine 55, no. 9, pp. 34-40, 2017

[9] 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.