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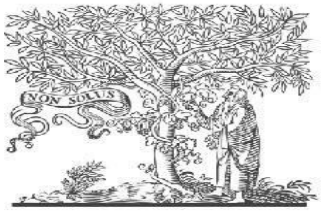

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IOT BASED MANHOLE MONITORING SYSTEM

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***Abstract*—A first-rate manhole management is a sign of good city. Manhole monitoring is an important element of municipal infrastructure as accidents due to broken and missing manhole lids are continual. Such accidents have the potential to cause severe injuries and even fatalities. Upon observation, it was noted that a significant number of manhole covers were not properly placed. Furthermore, inadequate monitoring of manholes is a common issue in developing nations. Poor governance and monitoring of the manholes is the fundamental cause of urban floods which are frequent in crowded cities. This problem can be overcome by using a Manhole Management Device based on IOT and Sensor Technology. Our plan is develop a IOT-based Manhole Monitoring device. Here, we have comprised an array of sensors for complete monitoring of the manhole's lid so that such accidents can be averted. This device includes a gas sensor to monitor the gases present in manholes so, that toxicity levels can be handled easily, an ultrasonic sensor to detect the water level, when the water level goes beyond a certain level and a tilt sensor is used to alert whether if the manhole cover is tilted. If any of these values exceeds the set/threshold values then we send an SMS to an authority number by Wi-Fi module to store in the cloud.**

***Keywords*— Node MCU, IOT, Buzzer, Sensors, Alert message, Threshold**

I. INTRODUCTION

Manholes are an essential part of modern urban infrastructure, providing access to underground networks of pipes, cables, and conduits. They are typically located in public areas, such as roads, sidewalks, and parks, and allow workers to enter and maintain these underground systems. While manholes serve a vital function in maintaining urban infrastructure, they can also pose safety risks if not properly maintained. For example, if a manhole cover is loose or missing, it can create a hazard for pedestrians and motorists. Additionally, if a manhole is not properly ventilated, it can build up dangerous gases, such as methane, which can be harmful to workers and the public.

For a fresh and hale environment, several Indian cities have sewage system that is handled by the Municipal Corporation. The water present in the drainage is occasionally mixed with pure water due to poor conservation, infections and diseases can be spread through the sewage system. In large cities where millions of people live, drainage systems play a very important role. If the drainage system is perfect, the city can be called as clean city. The primary objective of the drainage system is to facilitate the transportation of sewage, excess water, rainwater, and wastewater to the outskirts of the city while managing drought conditions

Nowadays manhole management is more important. Because damages in manhole cover leads to many accidents. It is very important to have a shielded manhole management system. Because the rate of accidents due to insecure manhole coverage is high. There is a chance of leakage of dangerous gases which causes explosion and even death too. If there is a small change in the angle of the manhole cover, it causes accidents. So the manhole management is very important.

Figure 1. Manual checking of manholes

Because of switching climatic conditions, drainage is affected throughout the year, and the environment is robust, the daily lives of the people are disrupted. Any drainage system's integral part is the access points into it when it

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get to the point of cleaning, clearing, and inspection.

Figure 2. Broken Manhole Cover

Metropolitan cities have implemented subterranean sewage systems, and it is imperative for the municipal corporation to ensure their cleanliness. Insufficient maintenance of sewage can lead to groundwater contamination and the spread of infectious diseases. Additionally, during the monsoon season, blockages in the drains disrupt the daily lives of the public. Manual drainage monitoring is not possible because the drainage network is too big. Certain measures have recently been taken by the concern departments to improve the cleanliness of the country.

One can bypass the drainage obstacles by regularly monitoring the drainage in the area. A significant number of committed individuals is necessary for this task. Elevated levels of gases result in fatalities. The absence of proper treatment and protection leads to the loss of lives among sewage cleaners consistently throughout the year. The installation and generation of data through manual systems pose both difficulties and dangers on every occasion. As a result, there is an increasing demand for automated data generation and monitoring.

Figure 3. Overflow of water from manholes

Hence, this warning about blockage and its appropriate location in manhole must be intimated to the corresponding officials and it helps to notify the people about the gas burst, rise in the water level and angle of manhole lid. Given the unfavorable environmental conditions, manual maintenance of manholes remains crucial in the meantime. To ensure the safety of both workers and the public, it is essential to monitor and maintain manholes regularly. This is where an IoT-based manhole monitoring system can play a critical role by providing real-time data on the condition of manholes and alerting authorities to any issues or anomalies.

II. Problem Statement

Urbanization has led to an increase in the number of manholes in cities around the world. These manholes are an essential component of the city's infrastructure, but they can pose a significant risk to public safety if they are not adequately maintained. Manholes are often located in areas with high foot traffic, making them vulnerable to accidental falls and injuries. Currently, manhole inspections and maintenance are done manually by city workers, which can be time-consuming and expensive. Furthermore, there is always a risk of human error, which could result in missed inspections or maintenance. Inadequate maintenance of manholes can lead to service disruptions, property damage and even public health risks. Conventional manhole inspection and maintenance practises involve periodic manual inspections by human operators, who may not have training, expertise, or resources to detect and address all issues.

To overcome these challenges, a manhole monitoring system can be developed that uses advanced sensors, communication technologies, and analytics to continuously monitor the condition and performance of manholes. So, this system proposes:

- The system governing the flow of sewage from the pipes.
- Use of sensors to detect the variations in the flow.
- Get the prior alerts of blockages and also locate them using IoT,that sends SMS too.

By developing a manhole monitoring system, cities can ensure that their infrastructure is safe and properly maintained while reducing the risk of injury to the public. This paper aims to describe the development and implementation of such a system and to evaluate its effectiveness in improving the safety and efficiency of manhole inspections and maintenance.

III. Existing System

In present days, the management of manholes are penurious. Because of this, the society facing difficult to have safe ride on the roads that leads

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to death. The society also has responsibility to inform the officials regarding the manhole condition, but they never do this. On other side, the person from the municipality has to check everytime and each manhole situation, where sometimes damaging of the property already take place. The person cannot detect the inner condition as it suddenly burst out and difficult to solve the issues.

Figure 4. Manual Monitoring of manholes

Because of improper manhole lids, it leads to accidents occasionally leads to death also. During seasonal changes, the condition goes terrible. In addition to causing population displacement, flooding can exacerbate health issues. Oftentimes, data integrity suffers as a result of manual data entry into registers or systems. Insufficient drainage frequently arises when contractors excavate topsoil during the construction of new houses, leaving only subsoil behind. Chance of mixing of groundwater and drainage water, if not taken proper care.

Figure 5. Traffic zones around open manholes

IV. Proposed System

Here we are proposing technology-based manhole monitor that helps the people in avoiding open manholes, overcome the overflow of water on the roads and also keep away from bad odour releasing from manholes. By placing ultrasonic sensor here helps to detect the water content in the drainage hole. In order to avoid accidents due to open manhole covers we are using tilt sensors that detects the manhole lid when tilted by an angle. Moreover, gas sensor also used to identify the gases present in the underground systems. The officials receive about the condition of these manholes behind time where the entire rubbish already happens. So, to send the notification regarding this we are using Wi-Fi in-built microcontroller unit. Node MCU updates the live values of all the sensors. We have included an array of sensors for complete monitoring of the manhole cover so that such accidents can be prevented.

V. Objective

1. Identification of water level in the drainage system and detection of any blockages present.
2. Monitoring the water flow rate continuously and initiating alerts if the water level deviates from the anticipated normal range.
3. Enhancing urban cleanliness and implementing intelligent drainage management within the city.
4. The primary goal is to achieve a cost-effective and adaptable solution that effectively monitors the condition and manages the infrastructure within the city.
5. Detecting the composition of the gaseous mixture and transmitting real-time updates via IoT technology.

VI. Working Of Proposed Model

A) Acronyms and Abbreviations

IOT, MCU, SMS, SOC, PCB, IDE, LED, USB.

B) Block diagram

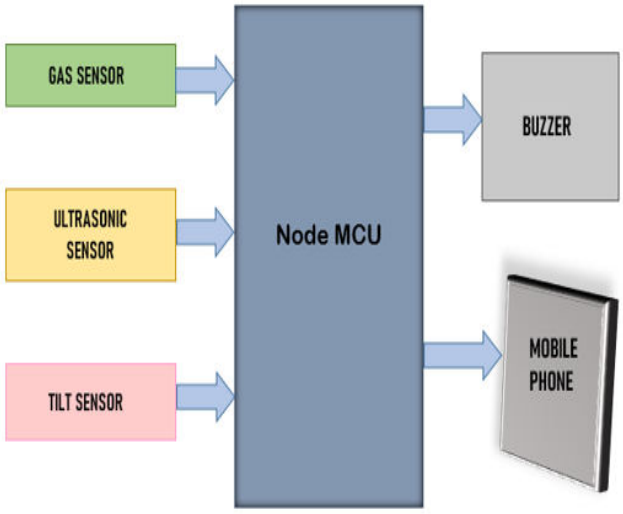

Figure 6. Block Diagram of proposed model

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The working behind this system is that it is used for special purpose as a monitoring device for the society. The block diagram of the system is shown in figure 6.

The system consists of various Hardware parts also software parts. The various sensors are integrated to monitor the mentioned parameters. Here we have used three sensors i.e., Gas Sensor, Ultrasonic Sensor, Tilt Sensor, and Buzzer. Gas sensor is used to detect the presence of Gas. The Ultrasonic Sensor is used to detect the water level and the Tilt sensor is used to detect whether the cover of the manhole is tilted or not.

C) Flow Chart

From the flow chart, it is understood that,

Step1: Initially, the hardware setup should be powered to start the process.

Step2: Then the microcontroller unit continuously take the input values from the sensors such as, ultrasonic, gas and tilt sensors.

Step3: If any of these sensor values exceed beyond the setup value the buzzer makes sound that indicating tilt sensor got detected and also send SMS to the authority member behalf of all these sensors. Finally process is going to be end.

Step4: If no any sensor is beyond its precise value then, simply display the sensor values in the mobile app.

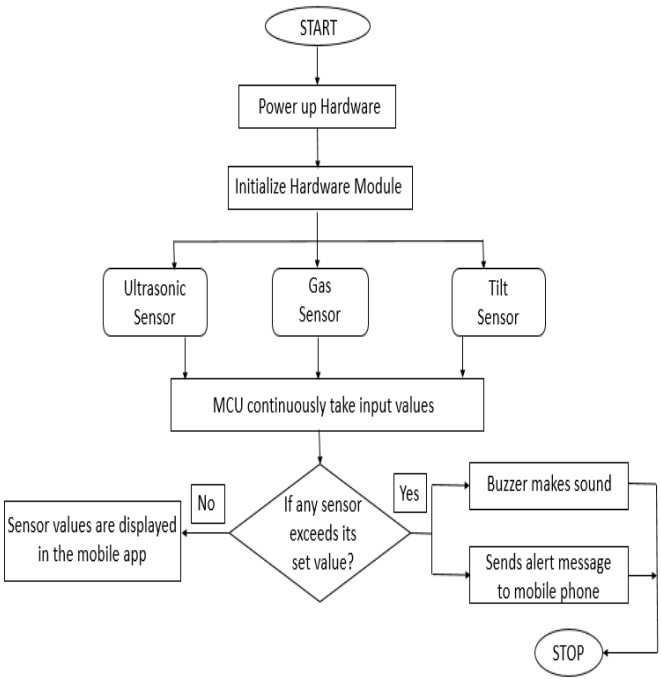

Figure 7. Flow chart of Manhole monitoring System

D) Circuit Diagram

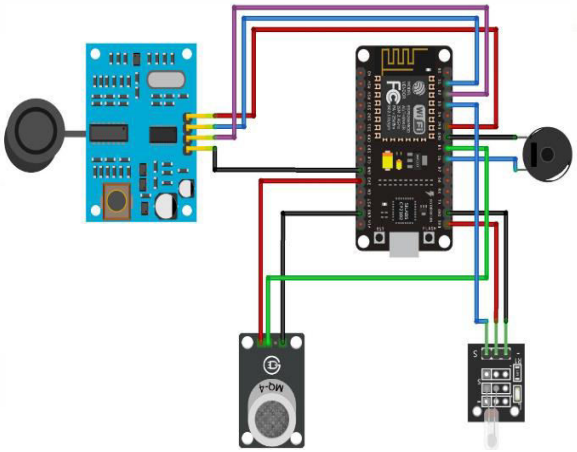

Figure 8. Schematic Diagram of proposed model

E) Operation

Due to missing and broken manhole lids, accidents are frequent. So, to monitor them in a proper condition we're designing a device that uses set of sensors which are connected to the main part of the device to the respective pins. To track the problem all the time is not possible in real time but using of this device definitely sense the fault within the manhole.

What is Tilt Switch Module?

It is also called as tilt sensor or tip over switch. This sensor helps in sensing the angle of device housing with respect to downward force of gravity.

Working of Tilt sensor?

These sensors consist of a rolling ball with a plate beneath them. When the sensor gets power the rolling ball falls to the bottom of the sensor to form an electrical connection. When the sensor is tilted, the rolling ball doesn't fall to the bottom so that the current cannot flow the two end terminals of the sensor.

Types of tilt sensors?

Single axis-single output, dual axis-dual output, dual axis-single output.

- Single axis, single output: The sensor responds to being tilted around one horizontal axis, relative to the downward force of gravity.
- Dual axis, dual output: The sensor contains two sensing elements at 90 degrees to each other. Each has an output which is determined by its angle of tilt from vertical around one axis.
- Dual axis, single output: A single sensor responds to an angle of tilt from vertical around any horizontal axis.

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Circuit that tilt sensor uses?

When the device gets power and is in its upright position, then the rolling ball settle at the bottom of the sensor to form an electrical connection between the two end terminals of the sensor. Next the circuit becomes short circuit and the LED gets sufficient current. If the circuit gets tilted so that the rolling ball doesn't settle at the bottom of the sensor with the electrical conduction path, then the circuit becomes open. This is about the circuit operation.

VII. Advantages And Applications

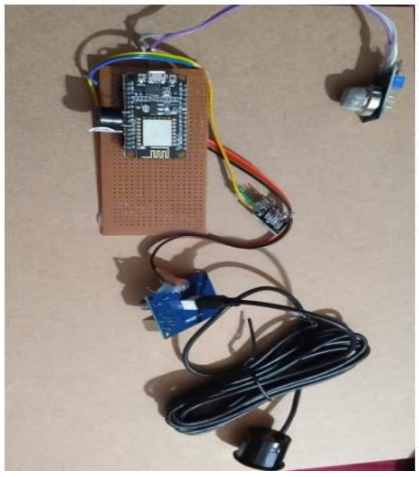
A) Advantages:

a. It is low cost.
b. Enables Real-time monitoring.
c. This system makes the smart city more scientific.
d. It helps to save people's life from unexpected accidents.
e. Intimate the improper manhole cover condition.
f. Monitor the toxicity and also detects the water flow beyond its normal flow range.
g. Improves efficiency.

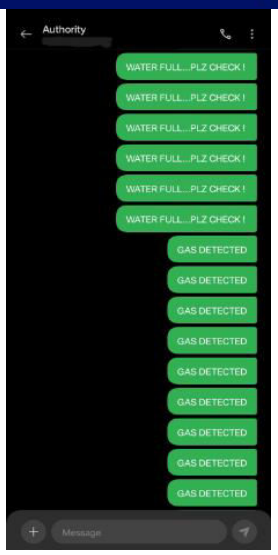
B) Applications:

a. Used in industrial and security control.
b. Used as emergency systems.
c. Remote sensing.
d. Used to monitor the concentration of toxic gases.
e. Alarm systems.
f. Used in avoiding obstacles.

VIII. Results



TOP VIEW OF IOT BASED MANHOLE MONITORING SYSTEM



ALERT MESSAGE TO THE OFFICIAL'S

IX. Conclusion

The design and implementation of the Manhole monitoring system based on IOT which was our aim and objective of the paper at the beginning ends with a success as both part works as desired. There it goes without any saying that our proposed model has the potential to overcome the traditional manual inspections by minimizing the need for human intervention and also problems due to conventional management of manholes because it's efficient and convenient. Our system offers a promising solution for cities and municipalities to monitor and manage their manhole infrastructure effectively. And with just some few modifications we can use our system in any secured facilities.

X. Future Scope

In the future, we can implement this project in an effective way. As we're using the sensors that helps to secure manholes from explosion of harmful gases. Still, if we want to update this system then using of GPS may help the authority member to find the location and react early to the emergency situation.

References

[1] Gaurang sonawane, chetan mahajan, anuja nikale , yogita dalvi, "smart real-time drainage monitoring system using internet of things", MAY 2018, IRE journals - volume 1.
[2] D.Sakthipriya ,V. Logeswari ,K. Nishanthi , B.Reethika "manhole monitoring system implemented in smart city" journal of analysis and computation (JAC) (an international peer reviewed journal), ISSN 0973-2861

international conference on emerging trends in IOT & machine learning, 2018.

[3] Rutvikpatel, jay prajapati , Meha dave, Ishwariy joshi, Jagdish M rathod, "IoT based wastewater spillage detection system", journal of physics: conference series.

[4] M Aarthi, A Bhuvaneshwaran, "Iot Based Drainage and Waste Management Monitoring and Alert System for Smart City"- Annals of the Romanian Society, 2021 - annalsofrscb.ro.

[5] S. Kelly, N. Suryadevara, S. Mukhopadhyay, "Towards the Implementation of IoT for Environmental Condition Monitoring in Homes" – IEEE Sensors Journal, Computer Science- DOI: 10.1109/JSEN.2013.2263379, May 2013.

[6] Prof S. A. Shaikh1, Suvarna A. Sonawane2, "Monitoring Smart City Application Using Raspberry PI based on IoT" International Journal of Innovative Science, Engineering & Technology, Vol 5 Issue VIL, July 2017.

[7] Gangyong jia, member, IEEE, guangjie han, member, IEEE, huanle rao, lei shu, "Edge computing based intelligent manhole cover management system for smart cities", journal of latex class files, 2017.

[8] S. R. Muragesh SK, "Automated IoT for underground Drainage and manhole monitoring System for Metropolitan Cities," International Journal of Information and Computation Technology., vol. 4,pp. 1211-1220,2014

[9] A pendharkar, J chillapalli, K dhakate, "iot based sewage monitoring system", available at SSRN, 2020, researchgate.Net

[10] Nitin asthana, Ridhima bahl. "Iot device for sewage Gas monitoring and alert system"

[11] R. Girisrinivaas and V. Parthipan, "drainage overflow monitoring system using iot (DOMS)," 2017 IEEE international conference on power, control, signals and instrumentation engineering (ICPCSI), chennai, 2017, pp.2133-2137. Doi: 10.1109/icpcsi.2017.8392094.

[12] U andrijasevic, J kocic, V nesic, "lid opening detection in manholes" 2020 - ieeexplore.Ieee.Org.

[13] Jyothi Chillapalli, Yogesh H. Jadhav "IoT based sewage Monitoring and alert System using Raspberry PI" Amity University, Mumbai, Maharashtra, 2020 – International Journal of Scientific Research in Computer Science and Engineering, Volume 6, Issue 4, ISSN : 2456-3307.

[14] Praveen Ramteke, Vinay Kale, Chandrashekhar Deshmukh "Application of IoT: Smart Manholes Based Underground Drainage system" 2020 IOSR Journal of Engineering (IOSRJEN), ISSN (e): 2250-3021, Vol. 10, Issue 1, Series – I, PP 19-24.

[15] B. Sumathy, G. Gowthaman, K. Hari Haran, G. Keerthee Rajan, A. Sweeto Jeison, "Sewage Level Maintenance using IoT." 2018, International Journal of Mechanical Engineering and Technology (IJMET). Volume: 9, Issue: 2, Pages: 389-397.

[16] Kumar, V. & Ramana, T.. (2022). Fully scheduled decomposition channel estimation based MIMO-POMA structured LTE. International Journal of Communication Systems. 35. 10.1002/dac.4263.

[17] V. M. Kumar and T. V. Ramana, "Position-based Fully-Scheduled Precoder Channel Strategy for POMA Structured LTE Network," 2019 IEEE International Conference on Electrical, Computer and Communication Technologies (ICECCT), Coimbatore, India, 2019, pp. 1-8, doi: 10.1109/ICECCT.2019.8869133.

[18] M. K. Vanteru, T. V. Ramana, A. C. Naik, C. Adupa, A. Battula and D. Prasad, "Modeling and Simulation of propagation models for selected LTE propagation scenarios," 2022 International Conference on Recent Trends in Microelectronics, Automation, Computing and Communications Systems (ICMACC), Hyderabad, India, 2022, pp. 482-488, doi: 10.1109/ICMACC54824.2022.10093514.

[19] Madhu Kumar Vanteru, K.A. Jayabalaji, Suja G. P, Poonguzhali Ilango, Bhaskar Nautiyal, A. Yasmine Begum,Multi-Sensor Based healthcare monitoring system by LoWPAN-based architecture,Measurement: Sensors,Volume 28,2023,100826,ISSN 2665-9174.

[20] Dr.M.Supriya, Dr.R.Mohandas. (2022). Multi Constraint Multicasting Analysis with fault Tolerance Routing Mechanism. Telematique, 21(1), 3544-3554.

[21] N.Sivapriya, T.N.Ravi. (2019). Efficient Fuzzy based Multi-constraint Multicast Routing with Multi-criteria Enhanced Optimal Capacity-delay Trade off. International journal of Scientific & Technology Research, 8(8), 1468-1473.

[22] N.Sivapriya, T.N.Ravi. (2019). A framework for fuzzy-based Fault Tolerant Routing Mechanism with Capacity Delay Tradeoff in MANET. International Journal of advanced

Science & Technology, 28(17), 420-429.

[23] P. Kiran Kumar, B.Balaji , K.Srinivasa Rao, Performance analysis of sub 10 nm regime source halo symmetric and asymmetric nanowire MOSFET with underlap engineering. *Silicon* 14, 10423–10436 (2022). https://doi.org/10.1007/s12633-022-01747-y

[24] Vaigandla, K. K. ., & Benita, J. (2023). A Novel PAPR Reduction in Filter Bank Multi-Carrier (FBMC) with Offset Quadrature Amplitude Modulation (OQAM) Based VLC Systems. *International Journal on Recent and Innovation Trends in Computing and Communication*, *11*(5).

[25] Karthik Kumar Vaigandla and B. J, Study and analysis of multi carrier modulation techniques – FBMC and OFDM, Materials Today: Proceedings, Volume 58, Part 1, 2022, Pages 52-56, https://doi.org/10.1016/j.matpr.2021.12.584

[26] Karthik Kumar Vaigandla, J.Benita, "PRNGN - PAPR Reduction using Noise Validation and Genetic System on 5G Wireless Network," *International Journal of Engineering Trends and Technology*, vol. 70, no. 8, pp. 224-232, 2022. https://doi.org/10.14445/22315381/IJETT-V70I8P223

[27] Karthik Kumar Vaigandla and J.Benita (2022), Novel Algorithm for Nonlinear Distortion Reduction Based on Clipping and Compressive Sensing in OFDM/OQAM System. IJEER 10(3), 620-626. https://doi.org/10.37391/IJEER.100334

[28] Karthik Kumar Vaigandla and Dr. J.Benita, "Filter Bank Multicarrier for Next Generation Wireless Communications: An Overview," Proceedings of International Conference on Artificial Intelligence, 5G Communications and Network Technologies (ICA5NT'23), ISBN: 978-93-94521-15-5, 2023, pp. 714-725.

[29] K. K. Vaigandla, "Communication Technologies and Challenges on 6G Networks for the Internet: Internet of Things (IoT) Based Analysis," *2022 2nd International Conference on Innovative Practices in Technology and Management (ICIPTM)*, 2022, pp. 27-31, doi: 10.1109/ICIPTM54933.2022.9753990.

[30] Karthik Kumar Vaigandla , Dr.J.Benita, "Study and Analysis of Various PAPR Minimization Methods," International Journal of Early Childhood Special Education (INT-JECS), Vol 14, Issue 03 2022, pp.1731-1740.

[31] P.Kiran Kumar, B.Balaji, K.Srinivasa Rao, Halo-Doped Hetero Dielectric Nanowire MOSFET Scaled to the Sub-10 nm Node. Transactions on Electrical and Electronic Materials (2023). https://doi.org/10.1007/s42341-023-00448-6

[32] Padakanti Kiran Kumar, Bukya Balaji, K.Srinivasa Rao, Design and analysis of asymmetrical low-k source side spacer halo doped nanowire metal oxide semiconductor field effect transistor, IJECE, Vol 13, No 3 DOI: http://doi.org/10.11591/ijece.v13i3.pp3519-3529.

[33] P. K. Kumar, K. Srikanth, N. K. Boddukuri, N. Suresh and B. V. Vani, "Lattice Heating Effects on Electric Field and Potential for a Silicon on Insulator (SOI) MOSFET for MIMO Applications," 2023 2nd Edition of IEEE Delhi Section Flagship Conference (DELCON), Rajpura, India, 2023, pp. 1-4, doi: 10.1109/DELCON57910.2023.10127385.

[34] P. K. Kumar, P. P. Rao and K. H. Kishore, "Optimal design of reversible parity preserving new Full adder / Full subtractor," 2017 11th International Conference on Intelligent Systems and Control (ISCO), Coimbatore, India, 2017, pp. 368-373, doi: 10.1109/ISCO.2017.7856019.

[35] V.Madhu Kumar,Dr.T.V.Ramana" Virtual Iterative Precoding Based LTE POMA

Channel Estimation Technique in Dynamic Fading Environments" International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-6, April 2019

[36] V.Madhu Kumar,Dr.T.V.Ramana, Rajidi Sahithi" User Content Delivery Service for Efficient POMA based LTE Channel Spectrum Scheduling Algorithm" International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-9 Issue-2S3, December 2019