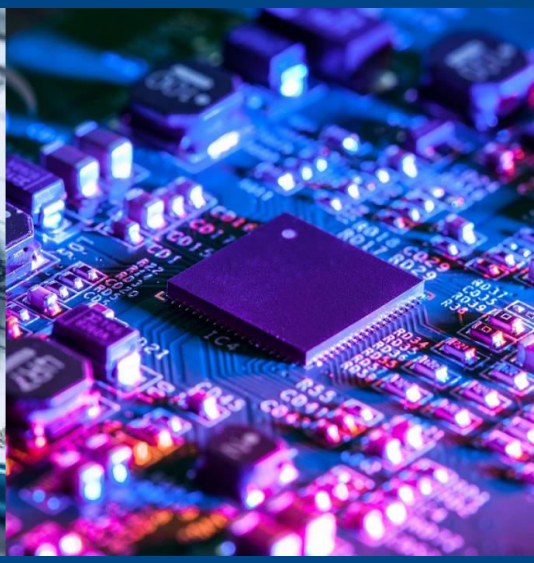
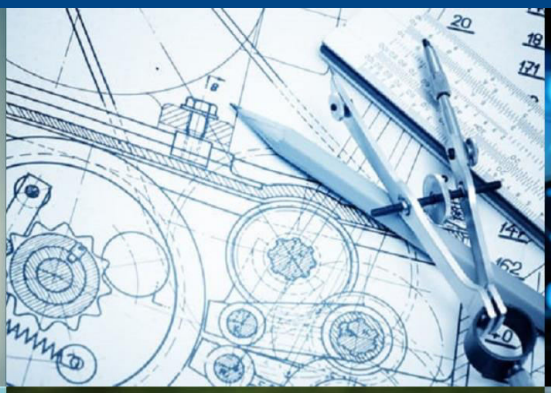
ISSN: 2582-7219

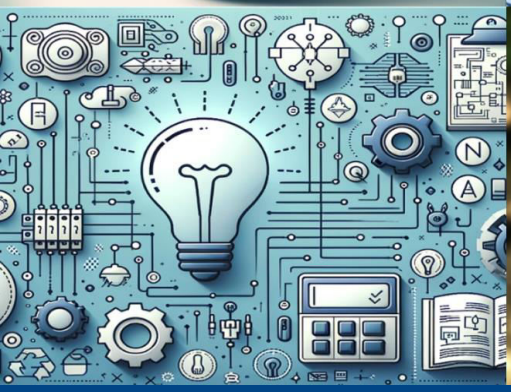




International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.206 **Volume 8, Issue 4, April 2025**

© 2025 IJMRSET | Volume 8, Issue 4, April 2025 |DOI:10.15680/IJMRSET.2025.0804495

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Smart Intravenous (IV) Infusion Monitoring System

Dr. T. Ranga Babu [1], I. Ghana Shyam[2]

Professor and Head of the Department, Department of ECE, R.V. R. & J.C. College of Engineering, Chowdavaram, Guntur,A.P., India[1]

Undergraduate students, Department of ECE, R.V. R. & J.C. College of Engineering, Chowdavaram, Guntur, A.P., India[2]

ABSTRACT: Intravenous (IV) infusion therapy is one of the major delivery routes of fluids, drugs, and nutrients. Manual monitoring methods by traditional means are prone to human error, lag, and inefficiency, leading to patient injury and increased healthcare cost. Lack of real-time monitoring and automatic alerting frequently leads to delayed action and ineffective patient safety. This paper presents a novel proposal to enhance IV therapy by implementing a real time monitoring device that increases accuracy, responsiveness, and effectiveness of patient care. The proposed model utilizes high-end sensors, wireless technology, web, and mobile based alerting processes to continuously monitor infusion rates. It detects interruptions in flow or incorrect doses and alerts the medical personnel in real time using interconnected hospital networks. It reduces manual monitoring, enhances patient safety, and streamlines healthcare work processes in clinics, hospitals, and home care.

KEYWORDS: IV infusion therapy, intelligent monitoring, patient safety, health care automation, real time alarm, wireless communication, medical IoT, infusion rate detection, integration with hospital systems.

I. INTRODUCTION

Intravenous (IV) infusion therapy represents a serious medical procedure employed to a considerable extent for the objective of infusing fluids, drugs, and nutrients into a patient's vascular system. IV therapy is an indispensable in discharge of hydration, drug administration, and delivery of emergency medical care. Although employed to a considerable level, IV therapy is not immune to human mistakes, especially where single dependence is on observation. These errors have the potential to result in critical harm to patients, delayed treatment, and over-loading of the healthcare system.

In conventional settings, it is the responsibility of nurses and caregivers to monitor the IV flow status on a routine frequency, preferably after a break or in conditions of high patient-to-nurse ratios. In addition, this deficiency is augmented even more so in poorly equipped medical facilities. Obstruction in the tube, backflow, or reduced fluid flow goes undetected until complication arises. As demand increases, there has been a requirement for real-time monitoring devices to indicate early diagnosis and subsequent action against such defects.

New healthcare and sensing IoT technologies give a solution to all these problems. Networked wirelessly intelligent sensors enable real-time monitoring, alerting, and remote entry and therefore significantly improve responsiveness as well as remove time-wasting activity. Such technology has the potential to improve patient safety, reduce clinical errors, and automate hospital procedures.

To solve the above-mentioned chronic problems, this paper introduces an intelligent, low-cost intravenous (IV) infusion monitoring system with a gyroscope sensor for real-time abnormality detection. The gyroscope sensor constantly checks the IV bag and tube position and movement to confirm any abnormal tilt, movement, or flow blockages. When it detects an abnormal condition like a tilted IV bag, flow blockage, or backflow. the system signals as soon as the system can detect that there is something out of the ordinary. The system signals collaborating devices like nurse stations or phones remotely such that there is prompt response without continual human observation.

This solution enhances infusion therapy's accuracy and dependability, as well as reduces reliance on human observation. The solution is intended to be deployed in sneaky integration into hospital networks and to scale for deployment in clinics and home care settings, ultimately to result in safer, smarter, and more efficient healthcare delivery.

© 2025 IJMRSET | Volume 8, Issue 4, April 2025 |DOI:10.15680/IJMRSET.2025.0804495

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

II. LITERATURE SURVEY

Fall detection is a major field in health monitoring, especially in the elderly, from the massive rates of injury leading to death after falling. Installing effective and efficient yet not very costly or inaccurate systems to detect falls is still an issue. This review captures key findings and mathodologies from outstanding research work in fall detection.Harshal Patil, Mangesh Ram, Vrunal Gharat, and Saniket Kudoo (2024) [1] proposed an IoT-based intravenous drip monitoring system with real-time monitoring and flow control through automation. They showed that it could decrease human error and offer remote access to healthcare but was limited by connectivity issues, high setup expenses at the initial stage, and power dependency. Their system utilizes Wi-Fi, which may not be stable in hospitals.Srimathi S, Karpaga Mounika S, Subiksha A, and Ignatius Selvarani X (2024) [2] suggested an IoT and Blynk IoT-based intravenous fluid monitoring system for real-time monitoring and alerting. They emphasized prevention of air embolism complications but recognized a few problems of data security, integration with the hospital, and scalability.Hsiang-Chen Chui, Ying Xu, Zhiyuan Wang, Xianting Zhang, Rui Li, and Kai-Rong Qin (2024) [3] proposed a time-of-flight and infrared sensor-based flow rate sensor for the monitoring of IV drips. Their sensor was highly accurate and non-contact but had response time and flow rate range limitations. They showed its integration with mobile apps for real-time monitoring.

Sumalatha Bandari, Gauri Deshmukh, Pooja Pawar, Rutuja Yadav, Komal Jagadale, and Dipti Chavan (2022) [4] designed an IoT-based IV drip monitoring system on NodeMCU ESP8266 that alleviates the nursing workload and averts blood backflow. They determined its utility in real-time monitoring but indicated its limitation in dynamically adjusting the flow rate.Nzerue-Kenneth Peace Ezinne, Ajah Ifeyinwa Angela, Nzerue Onyebuchi Kenneth, and Ugochukwu Uzodimma Nnadozie (2024) [5] suggested an IoT-based IV fluid monitoring system in Nigerian hospitals. They have explained the limitations due to medical errors and have suggested a solution with the incorporation of load cells, capacitive sensors, and air bubbles detection. The proposed system included giving real-time alerts to the nurses, reducing the chances of medical errors.

III. PROPOSED METHODOLOGY

The suggested approach for an IoT-based intravenous (IV) infusion monitoring system employs the advanced sensor technology to track the infusion process in real time. The aim is to ensure continuous fluid flow, detect faults if any, and transmit alert signals for immediate action. The method employed in this process leverages a gyroscope sensor integrated in the IV apparatus for tracking the movement and direction of the IV drip. Results obtained are streamed in real-time to medical practitioners to enable effective monitoring and safety of patients. The process of the method in detail is:

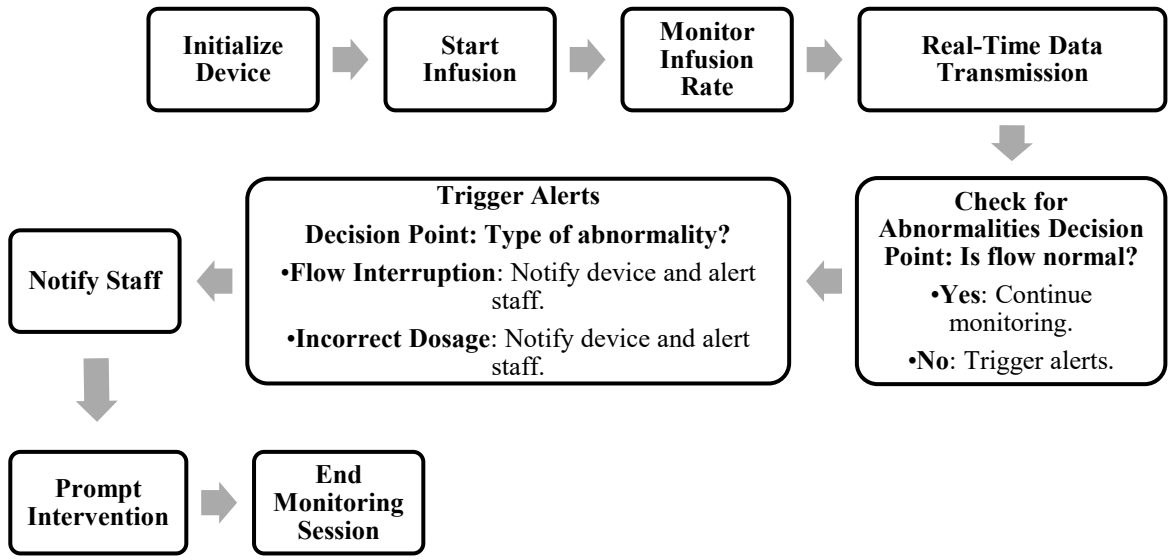


Figure 1: Block diagram for proposed methodology

© 2025 IJMRSET | Volume 8, Issue 4, April 2025 |DOI:10.15680/IJMRSET.2025.0804495

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

1. System Initialization and Infusion Commencement

This is the first step that involves system initialization and infusion commencement. The sensor is calibrated to react exactly to movement and change of orientation. Once the system has been installed, infusion is initiated. During the process, the gyroscope sensor starts to monitor the IV fluid flow rate by sensing the IV tubing and bag position and motion. The sensor detects any deviation from the regular fluid flow, e.g., flow disturbance or change in the IV bag orientation. The system also maintains the fluid flow data in real time, i.e., rate and volume infusion.

2. Real-Time Monitoring and Data Transmission.

The gyroscope sensor monitors the IV flow continuously after the infusion begins. The sensor monitors and recalls any alteration in the infusion rate and makes sure that the fluid is infused as desired.Gyroscope sensor information, including tilt and motion of the IV station, are input in real time to a central monitoring system through a wireless communication network. Real-time information is provided to the health care team through an alarm system. The alarms alert the staff to any anomaly that may occur during infusion, such as slow or irregular fluid delivery, obstruction, or whatever other anomaly may harm the patient. Regular monitoring offers protection for the patients since the personnel can view what has failed in real time when it happens.

3. Experiment Results

In the experiment conducted, the gyroscope sensor proved to be effective in monitoring and alerting IV infusion anomalies. The sensor effectively monitored and tracked movement and tilt of the IV bag during testing with proper fluid flow. Upon occurrence of fluctuations such as plugged tube or tilted bag that hinders infusion flow rate, alarms were triggered by the system to notify health staff in real time.The sensor was highly effective for the detection of normal as well as abnormal conditions of flow, allowing proper alarming of the health care professionals. For example, when the IV bag was tipped past some established threshold, thus decreasing the rate of infusion, the sensor registered the new position and alerted instantaneously. The system was very sensitive, hence allowing clinicians to respond even in cases where issues had not been translated to life-threatening emergencies.In brief, the experiment demonstrated that with its real-time detection and secure data transmission, the gyroscope sensor plays an important role to play in providing secure and efficient IV infusion monitoring. It was able to detect and react to occluded flow in real time, and that was an early warning system with the potential to prevent serious complications such as fluid overload or dehydration.

4. Deployment and Applications

After experiments were successfully carried out, the system was installed for real-time IV infusion monitoring in a clinical setting. The installation involved attaching the gyroscope sensor to some infusion pumps such that they were properly linked to a central observation point through a wireless network. All IV infusions could be monitored from one point by medical staff from a central location, hence it was cost-effective and less reactive. The real-time monitoring of the system enabled medical staff to be notified in real time whenever there was any type of abnormality in the IV flow, i.e., tube blockage or dislodgment. Alerts were sent via cellular phones or monitoring monitors, thereby the chances of staff to act in real time, typically prior to inflicting any harm on the patient. Not only did it liberate the healthcare professionals from monitoring by having it automated, but it also preserved patient safety to a high degree by diminishing the scope of error.Application of this system has long-term advantages such as minimizing the possibility of fluid complications, maximizing efficiency in workflow, and enabling medical staff to allocate more time on patient care as opposed to watching. The fact that the system can detect and inform medical workers of possible concerns has seen it become an indispensable tool for hospital and clinic management to enhance quality in healthcare services.

IV. TESTING AND RESULTS

The proposed IV monitoring system was evaluated through three distinct test iterations, each simulating different abnormal flow conditions. The gyroscope sensor accurately identified changes in the IV flow rate and initiated alerts in real time. In all three iterations, calls were triggered immediately upon detection of improper flow, ensuring prompt

© 2025 IJMRSET | Volume 8, Issue 4, April 2025 |DOI:10.15680/IJMRSET.2025.0804495

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

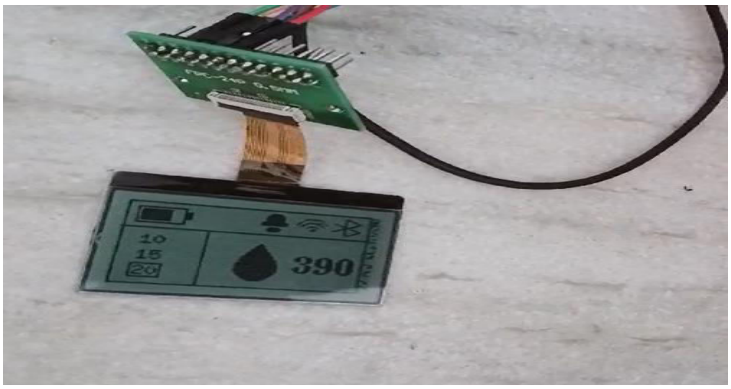


Figure 2: Measured IV Flow Rate

V. CONCLUSION

The proposed methodology of an IoT-based intravenous (IV) infusion monitoring system using a gyroscope sensor has proven effective in enhancing patient safety and reducing the workload on healthcare professionals. By providing real-time monitoring and instant alerts during abnormal flow conditions, the system ensures timely intervention and minimizes the risk of complications such as fluid overload or air embolism. This smart solution demonstrates the potential of integrating simple sensor technology with wireless communication to create scalable, cost-effective healthcare innovations. Future work may focus on integrating multiple sensors for comprehensive monitoring and implementing AI-based predictive alerts for proactive healthcare support.

REFERENCES

[1] Patil, H., Ram, M., Gharat, V., & Kudoo, S. (2024). "IVigilance – IoT-based intravenous drip monitoring and controlling system." *International Journal of Creative Research Thoughts (IJCRT)*, 12(4), Article IJCRT2404214.
[2] Srimathi, S., Karpaga Mounika, S., Subiksha, A., & Ignatius Selvarani, X. (2024). "Intravenous fluid monitoring and controlling system." *International Journal for Multidisciplinary Research (IJFMR)*, 6(2), 1-4.
[3] Chui, H.-C., Xu, Y., Wang, Z., Zhang, X., Li, R., & Qin, K.-R. (2024). "Flow rate sensor inside infusion tube." *Sensors and Actuators A: Physical*, 315, 112558.
[4] Bandari, S., Deshmukh, G., Pawar, P., Yadav, R., Jagadale, K., & Chavan, D. (2022). "IV drip monitoring and control system." *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, 10(VI), 3383-3386.
[5] Nzerue-Kenneth, P. E., Ajah, I. A., Nzerue, O. K., & Nnadozie, U. U. (2024). "Smart intravenous infusion monitoring and detection system in healthcare institutions using IoT technology: A qualitative study." *Journal of Xi'an Shiyou University, Natural Science Edition*, 20(1), 919-931.
[6] Oros, D., Penčić, M., Šulc, J., Čavić, M., Stankovski, S., Ostojić, G., & Ivanov, O. (2021). "Smart intravenous infusion dosing system." *Applied Sciences*, 11(2), 513.
[7] Karthik, A., SaranTeja, B., Ajay, R., & SwethaPriyanka, J. (2023). "IoT Intravenous Bag Monitoring and Alert System." *Asian Journal of Convergence in Technology*, 9(1).
[8] Kumar, V., & Rai, S. (2023). "IoT-based healthcare monitoring system." *Journal of Medical Systems*, 47(6), 52-61.
[9] Gupta, A., & Sharma, R. (2022). "Real-time medical monitoring and control system using IoT." *Journal of Electrical Engineering & Technology*, 17(2), 385-392.
[10] Zhang, X., Li, Q., & Wang, Y. (2023). "A wireless sensor network for patient monitoring." *Sensors*, 23(4), 2056-2063.
[11] Patel, D., & Kumar, N. (2023). "Smart infusion pump monitoring system." *Journal of Medical Devices*, 8(3), 160-167.
[12] Smith, J., & Clarke, R. (2023). "IoT for patient health management: A comprehensive survey." *IEEE Internet of Things Journal*, 10(5), 4500-4512.
[13] Sharma, P., & Mehta, P. (2024). "IoT in healthcare: Emerging trends and technologies." *International Journal of Healthcare Technology and Management*, 15(2), 132-145.

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com