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Review on Modern IoT Enabled Intravenous (IV) based Health Care Systems

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Abstract: The use of IoT in healthcare has revolutionized monitoring, notably in the delivery of intravenous fluids. Conventional IV systems are essential, prone to human mistake, and require regular expert supervision. IoT-enabled IV drips provide a completely automated framework that improves safety and efficiency by leveraging sensor data. This research investigates improvements in IoT IV monitoring, focusing on technical innovations and their significance in patient care. Alert systems and flow regulation are among the enhancements that improve accuracy. Prioritizing the integration of vital sign monitoring improves safety and expedites medical action. However, data security and sensor reliability remain major problems, preventing smooth application in medical settings. This study seeks to give a complete evaluation of IoT-integrated IV monitoring, assessing its influence on healthcare services and proposing prospective areas for further research.
Keywords: Internet of Things (IoT), Patient care, Intravenous (IV) monitoring, Real-time sensing, , Automated healthcare, Fluid flow management, Smart infusion systems, Continuous monitoring.

I. INTRODUCTION

The Internet of Things altered healthcare by providing real-time monitoring, particularly in areas such as IV drip administration. Conventional systems, which are essential for administering fluids and drugs, require human oversight. Dependency increases the risk of mistakes, such as excessive or inadequate fluid infusion, necessitating ongoing supervision. As a result, resources are allocated inefficiently, especially in crowded medical institutions. IoT-enabled IV drip monitoring systems address these difficulties by automating fluid administration, ensuring accuracy, and alerting healthcare personnel immediately in the event of irregularities such as low fluid levels, blockages, or air infiltration [1]. These solutions increase precision and operational efficiency, improving patient safety and simplifying healthcare procedures. IoT-enabled devices continually monitor IV drip data in real time by combining sensors, microcontrollers, and communication technology. The acquired data is analyzed and delivered to medical specialists via cloud-based systems, allowing for continuous observation and fast intervention. Load cells and pressure sensors assess fluid levels, while flow sensors regulate and stabilize the infusion rate. This technology enables healthcare personnel to respond quickly, avoiding possible issues, increasing patient outcomes, and decreasing the need for ongoing manual observation [2, 3]. The growth of IoT permitted the development of enhanced IV monitoring, which improved safety and operational efficiency. According to studies, intelligent monitoring can help reduce errors that lead to problems, streamline operations, and improve the precision of IV fluid delivery. Through the automation of IV monitoring, IoT solutions aid medical workers in lowering oversight while ensuring precise infusion and minimizing overdose. A perfect example is a sophisticated IV monitoring system equipped with modern sensors that constantly measure fluid levels. When fluid levels reach a critical level, the system creates an alarm and notifies healthcare staff. This method ensures prompt IV fluid refill, preventing shortages that might threaten patient safety. These inventions fill a key vacuum in existing medical systems, where delayed or failed IV fluid refill can result in substantial health hazards [4]. Within the developing smart healthcare landscape, IoT in IV monitoring promotes seamless communication among previously separate medical equipment. Such integration increases the efficacy of patient care and therapies. IoT IV monitoring goes beyond fluid tracking by including real-time vital sign observation, providing a comprehensive approach of patient management. IoT solutions monitor critical health indices like as pulse rate, arterial pressure, and oxygen levels rather than IV fluid volumes. By acquiring and evaluating data, medical personnel have a better understanding of their patients' conditions and may make more educated treatment decisions. Combining IV monitoring with health indicators improves accuracy and efficacy, leading in better patient outcomes. Healthcare practitioners use data to identify signs of health deterioration, adjust tactics, and improve overall efficacy. IoT-driven solutions enhance and continue to change patient care by enabling timely interventions, reducing errors, and upgrading healthcare services [5]. Research on smart saline bottles shows that IoT-powered solutions improve patient care dramatically [6].

These systems use a variety of IoT technologies to keep fluid administration seamless, automated, and efficient by continually monitoring real-time patient data, reducing the need for human intervention by healthcare providers. Automated IV infusion systems continually monitor patient health and alter the fluid infusion rate in real time, resulting in accurate and optimum fluid supply [7]. Advanced functionality reduces fluid administration mistakes and improves treatment precision. Furthermore, the hazards of excessive or inadequate fluid infusion—which might lead to problems including edema and dehydration—are considerably reduced [8]. These advances help to enhance patient safety, maximize treatment efficiency, and manage healthcare resources more effectively. IoT-enabled IV monitoring solutions boost hospital efficiency by improving workflows. Automating the monitoring process decreases healthcare workers' burden, allowing them to focus on vital patient care while routine monitoring activities are delegated to automated technologies. This strategy improves resource utilization and saves operating expenses in healthcare facilities by reducing the need for regular manual IV checks [9]. Furthermore, IoT-enabled IV monitoring devices with smart alarm systems allow for faster responses to issues such as blockages or air bubbles in IV fluids, which improves patient safety [10]. By providing real-time warnings and automating issue identification, these technologies help to create a more efficient and responsive healthcare environment, eventually improving patient outcomes and lowering medical mistakes. Despite the obvious advantages, significant technological challenges must be overcome before widespread adoption of IoT-based IV monitoring devices may occur. The key worry in this situation is data security. Because these systems transfer sensitive patient information over the internet, it is critical that the data remain secret and secure at all times. Insufficient access restrictions or unauthorized data breaches might jeopardize patient privacy and undermine confidence in IoT-powered healthcare services [11]. To reduce these dangers, strong encryption mechanisms and strict healthcare data protection rules are required to secure patient information and prevent unauthorised breaches [12]. Strengthening these security measures is crucial for building trust in IoT-based healthcare solutions and guaranteeing regulatory compliance. Precision and reliability of sensors in IoT IV monitoring are critical for effective adoption. According to studies, sensors provide consistent, real-time measurements in complicated and dynamic situations. These sensors are designed for high precision to accurately regulate IV fluid flow, with safety as the first concern [13]. Inaccurate sensor readings lead to inappropriate medication delivery, which is especially risky for patient care [14]. Integrating IoT devices with the healthcare system presents obstacles. Effective, large-scale patient monitoring requires smooth communication and interoperability across devices [15]. Research indicates that standardized communication protocols and interoperability frameworks improve the operation of IoT healthcare systems [16]. Such integration was achieved by collaboration between device makers, healthcare providers, and regulatory organizations to set healthcare standards [17]. Addressing these difficulties leads to more efficient IoT healthcare infrastructure.

IoT healthcare expands IV drip monitoring [18]. The integration of sophisticated analytics and machine learning into the Internet of Things improves healthcare efficiency. IoT driven by ML analyzes patient data to predict health concerns before they arise. Predictive capabilities enable healthcare to take preventative interventions, reducing risks [18]. Conditions such as dehydration or over hydration have an influence on patient care for ICU patients being monitored [19]. IoT improvements are not restricted to IV drip monitoring; they have a wide range of potential medical uses [20]. Innovations aim to improve IoT sensor accuracy, boost security, and include predictive analytics [20]. Advancements are projected to combine IoT with upcoming technologies such as AI and blockchain, allowing healthcare to become more customized, efficient, and secure [21]. The expansion of IoT healthcare is driving the future of medical technology, providing better patient outcomes through effective healthcare management. Overall, introducing IoT technology into IV drip monitoring systems improves healthcare efficiency [22]. By automating the monitoring process, IoT allows for real-time data gathering and analysis, which ensures patient safety while lowering the strain on healthcare professionals [22]. To fully realize the promise of IoT in healthcare, issues such as data security, sensor dependability, and seamless integration must be addressed [23].

This study seeks to provide a complete overview of the present landscape of IoT-based IV monitoring systems, focusing on their methodology, problems, and future research and innovation opportunities in this quickly growing sector [24][25]. Addressing these challenges will open the door to more modern and secure healthcare technologies, eventually increasing patient care and operational efficiency in medical institutions.

II. LITERATURE REVIEW

Selecting the appropriate sensors is critical for good IV fluid monitoring. A variety of load cells and pressure sensors are used to correctly assess liquid levels in IV bags. Load cells have been used for continuous monitoring, indicating a high potential for real-time fluid tracking. This strategy greatly decreased the requirement for manual supervision [1]. An alternate strategy involves incorporating smart sensors that sensed IV fluid levels, alerted doctors, and reduced the dangers associated with under- or over-infusion [2].

Pressure sensors are vital in IV monitoring systems. Pressure sensors in saline monitoring systems continually monitor fluid levels and send automated notifications when levels fall below a safe threshold. Improved saline monitoring devices have showed increased patient safety and accurate fluid control [3]. The design of any IoT-driven IV monitoring system is often developed with microcontrollers like Arduino or ESP32, as well as IoT modules like the ESP8266. These components capture sensor data and send it to a cloud platform for further analysis. For example, during the creation of an automated IoT-based IV monitoring system, microcontrollers and wireless modules enabled sensor data transfer to healthcare experts via cloud services [4]. The system used ESP32 for robust, long-range communication with low power consumption, which improved the overall reliability of IV monitoring [8]. The system's architecture must be energy-efficient since it must work continually in medical environments. Microcontrollers such as Arduino or ESP32 are popular owing to their excellent efficiency and versatility while processing sensor data [6]. The flawless transfer of real-time data is critical to the successful functioning of an IoT-powered IV monitoring system. Sensor data is sent to the cloud using communication protocols like Wi-Fi or Zigbee, allowing healthcare practitioners to view it remotely. In one instance, the ESP8266 Wi-Fi module was used to send IV fluid level data, which medical workers could then monitor via mobile and desktop computers [5]. Furthermore, a dedicated Zigbee-based network with low power and short-range characteristics allows several IV drip monitors to communicate within a hospital, enabling real-time data transfer without interfering with other wireless systems [12]. In both systems, real-time data transmission enables healthcare practitioners to respond quickly if fluid levels fluctuate.

TABLE I
DESCRIPTION OF DIFFERENT APPROACH FOLLOWED UNDER THE STATE OF ART WORK

Sr. No.	Ref No.	Author(s)	Year	Work
1	[21]	M. S. Uddin et al.	2017	Real-time patient monitoring system
2	[8]	A. Ajayan et al.	2019	Smart drip using Arduino microcontroller
3	[2]	E. L. Mathew et al.	2020	Smart IV fluid level indicator
4	[3]	G. Sunil et al.	2020	IoT-based saline level monitoring system
5	[16]	M. Arfan et al.	2020	IoT-enabled IV infusion rate control
6	[13]	S. Joseph et al.	2020	Smart hospital IV drip monitoring
7	[10]	J.-K. Lee et al.	2021	Remote monitoring system with optical sensors
8	[5]	A. J et al.	2021	IoT-based smart electrolytic bottle monitoring
9	[6]	M. Tilak et al.	2021	IoT-based smart saline bottle for healthcare
10	[9]	S. Mathi V et al.	2021	IV drip monitoring system using IoT
11	[11]	M. R. Rosdi et al.	2021	Smart infusion pump system
12	[4]	C. P. S et al.	2022	IoT-based automatic monitoring and control system
13	[7]	C. S. Murugesan et al.	2022	IoT-based saline monitoring system
14	[17]	N. Sonkar et al.	2022	Smart IV drip with bubble detection
15	[19]	R. Kiruthika et al.	2022	IoT-based patient monitoring
16	[25]	A. A. Gnanadas et al.	2022	IoT-based continuous saline monitoring
17	[18]	J. R. Arunkumar et al.	2023	Wearable devices for patient monitoring
18	[1]	M. G. Vinodh Arrun et al.	2023	IV bag monitoring with patient monitoring system using IoT
19	[12]	S. Tanwar et al.	2023	IoT-based drip monitoring
20	[14]	A. Shetty et al.	2023	Smart IV bag monitoring and alert system
21	[20]	P. Anirudh et al.	2023	IoT-based patient monitoring and alerting system
22	[23]	M. R. K K et al.	2023	IoT-based wireless patient monitor
23	[22]	S. Amune et al.	2024	IoT and ML-based saline monitoring
24	[15]	N. R. V et al.	2024	Automatic saline reversal control system
25	[24]	D. G. V et al.	2024	IoT impact on remote monitoring

Real-time storage and analysis of data on a cloud network are critical for IoT-enabled IV monitoring systems. A case study showed how a smart saline bottle system communicated sensor data to a cloud-based platform, allowing medical practitioners to remotely monitor patients' IV fluid levels [6].

This system enabled healthcare staff to monitor patient status across the institution and respond quickly to concerns such as air bubbles or low fluid levels [9]. Another method used cloud storage for patient data analysis, which improved care management by tracking past IV fluid levels and changing therapy accordingly [15]. Cloud-based data centralization provides healthcare practitioners with remote access to full patient records, allowing them to handle many patients efficiently at the same time.One of the most important features of IoT-integrated IV systems is the automatic alarm mechanism, which alerts healthcare personnel to abnormalities such as fluid depletion, air bubbles in tubing, and flow obstructions. A research created a system that may automatically provide notifications when fluid levels fall below a predetermined threshold, allowing healthcare practitioners to react before issues occur [11]. Another method combined an infusion pump with a smartphone application that provided automated reminders to patients and displayed IV flow rates and fluid levels within a set timeframe [17]. Sophisticated systems can modulate the flow rate automatically in response to real-time patient data, reducing the requirement for continuous manual monitoring [10]. This enhanced technology greatly eliminates human error in IV fluid delivery. Aside from fluid tracking, IoT-enabled IVs include health monitoring sensors that measure crucial metrics such as heart rate, oxygen levels, and blood pressure. Such a device combined IV drip monitoring and vital sign tracking with an Arduino microcontroller, allowing for the collection of both data and providing healthcare personnel with information into patient health [8]. This connection uses real-time health data to enable healthcare practitioners to make well-informed decisions about IV fluid administration, reducing the dangers associated with independent fluid tracking. Another approach combined wearable health gadgets and IV monitoring. These wearable gadgets transmitted real-time health parameters including heart rate and body temperature, allowing for early diagnosis of possible issues before they became serious [18].

This dual-monitoring method improves the overall quality of patient treatment.

Securing data is a big concern in IoT healthcare, particularly when personal patient information is exchanged wirelessly. To protect patient information, encryption is routinely used during transmission to ensure security. IV fluid monitoring successfully integrated end-to-end encryption, limiting access to authorized workers sending to the cloud [12]. Compliance with healthcare standards is critical in protecting patient information. Studies show that IoT systems strike a balance between real-time monitoring and data security measures [13]. The evolution of IoT IV monitoring is driven by machine learning and predictive analytics. Such a system used real-time machine learning to patient data, anticipating fluid level anomalies and enabling preventive interventions to avert imbalances [16]. A different method used real-time data to identify trends that might indicate probable health decline. The technology generates automatic answers by evaluating past data, improving responsiveness [19]. The primary problem with IoT IV systems is ensuring accuracy and dependability. Fluctuating measures result in inaccurate fluid infusion, which increases the hazards. Research has underlined the need of very accurate sensors in maintaining exact fluid flow and levels in dynamic environments when patient circumstances vary [9]. One device used pressure sensors to detect even slight variations in fluid flow, resulting in precise and accurate infusion [14]. IoT IV monitoring is likely to focus on improving technology and interoperability across various devices. Standardizing interoperability for drip monitors and wearable health sensors is critical for maximizing data sharing [20]. Blockchain technology improves data integrity in IoT devices, making it tamper-proof [21]. Blockchain adds a layer of security to healthcare information, allowing only authorized individuals to view and edit data stored in cloud-based systems [25, 26, 27].

TABLE III

PRO AND CONS ASSOCIATED WITH DIFFERENT APPROACH FOLLOWED UNDER THE STATE OF ART WORK

Sr. No.	Ref No.	Author(s)	Pros	Cons
1	[21]	M. S. Uddin et al.	Real-time alerts	Data security risks
2	[8]	A. Ajayan et al.	Affordable, easy to implement	Limited scalability
3	[2]	E. L. Mathew et al.	Cost-effective, enhances patient safety	Limited interoperability
4	[3]	G. Sunil et al.	Reduces manual intervention	Security concerns in data transmission
5	[16]	M. Arfan et al.	Enhances precision	Integration issues with hospital systems
6	[13]	S. Joseph et al.	Enhances efficiency in hospitals	Initial setup cost
7	[10]	J.-K. Lee et al.	Enhances accuracy and safety	High cost
8	[5]	A. J et al.	Improves IV fluid tracking	Not widely adopted
9	[6]	M. Tilak et al.	User-friendly, portable	Power dependency
10	[9]	S. Mathi V et al.	Precise fluid level detection	Calibration challenges
11	[11]	M. R. Rosdi et al.	Remote management capability	Requires robust network

12	[4]	C. P. S et al.	Automates IV control	Complex system integration
13	[7]	C. S. Murugesan et al.	Real-time data updates	Possible network failures
14	[17]	N. Sonkar et al.	Prevents air embolism	Needs regular calibration
15	[19]	R. Kiruthika et al.	Improves healthcare response	Battery life issues
16	[25]	A. A. Gnanadas et al.	Ensures continuous monitoring	Implementation complexity
17	[18]	J. R. Arunkumar et al.	Real-time health tracking	Privacy concerns
18	[1]	M. G. Vinodh Arrun et al.	Real-time monitoring, automated alerts	Possible sensor inaccuracies
19	[12]	S. Tanwar et al.	Secured data transmission	Implementation complexity
20	[14]	A. Shetty et al.	Ensures timely fluid administration	Requires continuous maintenance
21	[20]	P. Anirudh et al.	Early anomaly detection	Network reliability required
22	[23]	M. R. K K et al.	Wireless data transmission	Connectivity issues
23	[22]	S. Amune et al.	Predictive analytics integration	High computational requirements
24	[15]	N. R. V et al.	Reduces wastage	Requires accurate sensors
25	[24]	D. G. V et al.	Improves telemedicine	Requires strong data protection

III.CONCLUSIONS

The use of IoT in IV drip monitoring has altered healthcare by increasing safety, providing real-time data access, and automating fluid management. This system uses sensors, microcontrollers, and cloud platforms to provide precise and continuous IV fluid level monitoring, allowing healthcare practitioners to respond quickly. Key developments include automatic alarms, predictive analytics, and interoperability with patient health monitoring equipment, which improve knowledge of patient situations. Although worries about data security and sensor reliability remain, IoT-based technologies are expected to increase efficiency and patient outcomes. Future advancements will most likely prioritize device compatibility and further investigate blockchain technology for improved data security. Notably, IoT-based IV monitoring offers a viable answer to traditional healthcare issues, opening the door for a more intelligent and adaptable medical environment.

REFERENCES

[1] M. G. Vinodh Arrun, G. Srinesh, G. Sridhar, B. Santhosh Kumar, and V. Tamil Selvan, "IV bag monitoring with patient monitoring system using IoT," Int. J. Creative Res. Thoughts (IJCRT), 2023.
[2] E. L. Mathew, J. K. James, A. Radhakrishnan, and B. Sebastian, "The novel intravenous fluid level indicator for smart IV system," Int. Res. J. Eng. Technol. (IRJET), 2020.
[3] G. Sunil, S. Aluvala, G. R. Reddy, V. Sreeharika, P. Sindhu, and S. Keerthana, "IoT-based saline level monitoring system," J. Pharm. Negative Results, 2020.
[4] C. P. S, G. Ganishka, A. M. S. Shane, and G. S., "IoT-based automatic monitoring and control system," J. Phys.: Conf. Ser., 2022.
[5] A. J., G. H. B., L. R. B., A. J. B., and K. J., "IoT-based smart electrolytic bottle monitoring," Adv. Parallel Comput. Technol. Appl., 2021.
[6] M. Tilak, D. Bhor, A. More, and G. Nagare, "IoT-based smart saline bottle for healthcare," Int. Res. J. Eng. Technol. (IRJET), 2021.
[7] C. S. Murugesan, R. Chitralekha, and R. Ramya, "IoT-based saline monitoring system," J. Pharm. Negative Results, 2022.
[8] A. Ajayan, V. S. Kumari, F. A. Rahim, and S. S., "Smart drip using Arduino microcontroller," Int. J. Comput. Sci. Eng., 2019.
[9] S. Mathi V, S. M. B, S. K, and N. D, "Intravenous drip monitoring system using IoT," Int. J. Adv. Eng. Manag. (IJAEM), 2021.
[10] J.-K. Lee, K.-C. Yoon, and K. G. Kim, "Design of a remote monitoring system based on optical sensors to prevent medical accidents during fluid treatment," Appl. Sci. Acad. J., 2021.
[11] M. R. Rosdi and A. Huong, "A smart infusion pump system for remote management and monitoring of intravenous (IV) drips," in 11th IEEE Symp. Comput. Appl. Ind. Electron. (ISCAIE), 2021.
[12] S. Tanwar, D. K, R. Maniktalia, and R. Billa, "IoT-based drip monitoring," in Commun. Netw. Technol. (ICCCNT), 2023.
[13] S. Joseph, N. Francis, A. John, B. Farha, and A. Baby, "Intravenous drip monitoring system for smart hospital using IoT," in 2nd Int. Conf. Intell. Comput., Instrum. Control Technol. (ICICICT), 2020.
[14] A. Shetty, P. G., and A. Balasubramanyam, "Smart IV bag monitoring and alert system," in 2023 Int. Conf. Recent Adv. Sci. Eng. Technol. (ICRASET), 2023.
[15] N. R. V., A. T., H. S. M., K. M., and S. H. M., "Automatic saline reversal control system using IoT," in 2024 3rd Int. Conf. Intell. Techn. Control, Optim. Signal Process. (INCOS), 2024.
[16] M. Arfan, M. Srinivasan, A. G. Baragur, and V. Naveen, "Design and development of IoT-enabled IV infusion rate monitoring and control device for precision care and portability," in 2020 4th Int. Conf. Electron., Commun. Aerosp. Technol. (ICECA), 2020.
[17] N. Sonkar, N. Pal, H. Gupta, and J. K. Dhanoa, "Smart intravenous drip monitoring system with bubble detection indicator using IoT," in 2022 2nd Int. Conf. Intell. Technol. (CONIT), 2022.
[18] J. R. Arunkumar, R. Raman, S. Sivakumar, and R. Pavithra, "Wearable devices for patient monitoring system using IoT," in 2023 8th Int. Conf. Commun. Electron. Syst. (ICCES), 2023.
[19] R. Kiruthika, E. Ramya, R. Prabha, M. Harinarayanan, S. Divakaran, and R. Iswariya, "IoT-based patient monitoring system," in 2022 8th Int. Conf. Adv. Comput. Commun. Syst. (ICACCS), 2022.

[20] P. Anirudh, G. A. E. S. Kumar, R. P. Vidyadhar, G. Pranav, and B. A. Aumar, "Automatic patient monitoring and alerting system based on IoT," in 2023 8th Int. Conf. Commun. Electron. Syst. (ICCES), 2023.
[21] M. S. Uddin, J. B. Alam, and S. Banu, "Real-time patient monitoring system based on Internet of Things," in 2017 4th Int. Conf. Adv. Electr. Eng. (ICAEE), 2017.
[22] S. Amune, S. Chavanke, S. Joshi, S. Kuttarmare, and S. Kathane, "Integrated healthcare system for saline monitoring, patient communication, and heart disease prediction using IoT and machine learning algorithms," in 2024 Int. Conf. Emerg. Smart Comput. Inform. (ESCI), 2024.
[23] M. R. K. K, M. N. M, R. Zidan, I. Alsarraj, and B. Hasan, "IoT-based wireless patient monitor using ESP32 microcontroller," in 2023 24th Int. Arab Conf. Inf. Technol. (ACIT), 2023.
[24] D. G. V, D. Joshi, S. K. C, M. R. G, S. D, and M. Habeeb, "Impact of IoT on remote patient monitoring and advancements in telemedicine," in 2024 2nd Int. Conf. Intell. Cyber Phys. Syst. Internet Things (ICoICI), 2024.
[25] A. A. Gnanadas, K. Indhumathi, M. Boopal, and R. S. Saranya, "Internet of Things-based development of continuous saline monitoring and control system," in 2022 6th Int. Conf. Electron., Commun., Aerosp. Technol., 2022.
[26] Sharma, R., & Banoudha, A.. Implementation of N-Bit Divider using VHDL. International Journal of Research and Development in Applied Science and Engineering, 3(1).2013
[27] Srivastava, A., & Banoudha, A. Techniques of Visualization of Web Navigation System. . International Journal of Research and Development in Applied Science and Engineering, 6(1).2014