IoT Based Saline Level Monitoring System and Alert System Based on Node MCU WiFi Technology

Prof. Vivekanand Thakare1, Mr. Vilap Bisen2, Mr. Sagar Gupta3, Mr. Rahul Bhanarkar4, Mr. Palash Bhoskar5
[1]*Assistant Professor, Department of computer science & Engineering,*
[2,3,4,5]*Students, Department Computer Science Engineering,*
Govindrao Wanjari College of Engineering and Technology, Nagpur,

Abstract- **As the global population continues to grow, the demand for effective healthcare solutions is also increasing rapidly. In recent years, significant advancements in medical care have been achieved due to technological progress in sensors, microcontrollers, and computing systems, all aimed at enhancing patient recovery and safety. A fundamental requirement for hospitalized patients is timely and efficient monitoring and delivery of essential treatments. One of the most common and critical treatments administered in hospitals is intravenous (IV) saline therapy, which is used to combat dehydration and support patient recovery.**

Traditionally, monitoring the saline level during administration requires constant supervision by medical staff or caretakers. However, due to human error, negligence, or workload constraints, delays in responding to empty saline bottles can lead to serious medical complications. To address this issue and improve patient safety, we propose an IoT-based automated saline level monitoring and alert system. This system uses NodeMCU with Wi-Fi capabilities to detect saline levels in real time and issue timely alerts, ensuring prompt intervention and continuous patient care.

Index Terms- **Intravenous, Internet of Things(IoT), NodeMCU, Saline, Servo Motor, Arduino Microcontroller**

I. INTRODUCTION

In the rapidly evolving field of healthcare, the integration of technology into patient care has become increasingly vital. As hospitals and medical institutions face the dual challenge of increasing patient numbers and the need for enhanced treatment quality, automation and real-time monitoring systems are becoming essential components in delivering effective medical services. One critical aspect of patient care, especially for those admitted in critical or postoperative conditions, is the administration of intravenous (IV) saline. This treatment helps maintain fluid balance, deliver medications, and ensure adequate hydration. Traditionally, saline administration requires constant observation by nurses or medical staff to ensure the fluid is not depleted, as an empty IV bag may lead to air entering the bloodstream, potentially causing life-threatening complications. Due to human limitations, such as fatigue e, multitasking, or understaffing, continuous manual monitoring may not always be feasible, which increases the risk of accidental harm to patients.

To address these challenges, the integration of Internet of Things (IoT) technology provides a promising solution. By using smart sensors, microcontrollers, and wireless communication modules, real-time saline level monitoring systems can be developed to alert medical staff automatically when the saline level reaches a critical threshold. In this project, a NodeMCU-based IoT system is proposed to monitor the level of saline in IV bottles and trigger alerts via Wi-Fi when attention is required. This system reduces the dependency on manual observation, enhances patient safety, and allows healthcare providers to optimize their time and focus on more critical tasks. The system utilizes ultrasonic sensors to detect fluid levels, a NodeMCU microcontroller for processing and connectivity, and an alert mechanism (such as a buzzer or message notification) to inform caregivers in real time. The implementation of such a system can play a vital role in preventing saline-induced medical complications and represents a step toward smarter and safer healthcare environments.

II. LITERATURE REVIEW

1. An IoT Based Smart Water Quality Monitoring System using cloud

Ajith et al. proposed an IoT-enabled system for real-time water quality monitoring by integrating sensors and cloud technology. The system continuously tracks important water parameters such as pH, turbidity, temperature, and conductivity using appropriate sensors connected to a microcontroller. These values are then transmitted to a cloud platform via a Wi-Fi module for storage, visualization, and remote access. The key contribution of this study is its demonstration

of how IoT and cloud computing can be effectively combined to provide remote monitoring and alert systems. While the project is focused on environmental applications, the methodology and architecture are highly adaptable to healthcare scenarios—such as intravenous (IV) saline monitoring— where real-time data, alerts, and cloud access are essential for patient safety and system automation.

2. **Patel et al. (2022) – Bluetooth-Enabled Saline Alert System**
   In their work, Patel et al. proposed a saline monitoring system that used Bluetooth communication to send alerts when the IV fluid neared completion. The system was simple and effective for small-scale use, especially in rooms where the caretaker was nearby. However, the major drawback was its limited communication range, making it impractical for use in large hospitals or for monitoring multiple patients simultaneously.

3. **Kumar et al. (2020) – Weight Sensor-Based IV Detection**
   Kumar and his team designed a system using load cells (weight sensors) to detect changes in the saline bottle's weight. This method provided accurate fluid level detection by constantly comparing the initial and current weight. While precise, the system required a stable placement and calibration of sensors, making it complex and expensive for wide deployment**.**
4. **Rao et al. (2019) – Infrared (IR) Sensor Saline Monitoring**
   Rao implemented an IR-based saline monitoring technique where infrared light was used to detect the fluid level. Though this method was low-cost and simple to set up, it was highly sensitive to environmental lighting conditions and the transparency of the bottle, which often led to inaccurate readings or false alerts.

5. **Meena et al. (2021) – Ultrasonic Sensor for IV Monitoring**
   Meena et al. introduced a system that used ultrasonic sensors to detect the fluid level in IV bottles by measuring the distance from the sensor to the liquid surface. The method was noncontact and hygienic, making it ideal for clinical settings. However, their system lacked wireless connectivity, and the monitoring had to be done manually or through local display units.

6. **Buzzer Caution**
   A buzzer caution informs healthcare experts when saline volume is moo, guaranteeing convenient substitution and persistent security.

7. **Program Components •**
   Thing Talk:
   A cloud-based IoT stage for collecting, putting away, analyzing, and visualizing real-time sensor information.
- MIT App Creator:
  user-friendly, block-based programming stage utilized to create an app featuring real-time information visualization, alarm notices, and quiet data administration.

III. PROPOSED WORK

The proposed system aims to automate the monitoring of saline levels in IV bottles and generate timely alerts to prevent potential medical risks due to unattended empty saline bags. This system uses an ultrasonic sensor to detect the level of saline in the bottle and a NodeMCU (ESP8266) microcontroller with built-in Wi-Fi capability to send alerts in real-time.

System Components:

Ultrasonic Sensor (HC-SR04): Measures the distance between the top of the saline bottle and the fluid level to determine how much saline remains.

NodeMCU (ESP8266): Acts as the central controller. It processes sensor data and connects to a Wi-Fi network to transmit alerts.

1. Buzzer/LED Indicator: Provides local (on-site) alerts when saline drops below a defined threshold.
   - The ultrasonic sensor is mounted above the saline bottle and measures the distance to the fluid surface.
   - The NodeMCU reads this distance and calculates the remaining saline level.
   - When the saline level falls below a preset threshold, the NodeMCU triggers:
     - A **local alert** (buzzer or LED).
     - A **remote alert** through Wi-Fi (notification on a mobile app or dashboard).
   - This ensures that medical staff are notified in time to replace or refill the saline bottle.

This proposed framework gives a cost-effective, effective, and solid arrangement

to upgrade healthcare checking utilizing IoT and NodeMCU innovation.

IV. APPLICATIONS AND ADVANTAGES

Applications:

1. Hospitals and Clinics

- Automatically monitors saline levels for multiple patients.
- Alerts nurses or medical staff when saline is about to finish.
- Reduces workload and improves efficiency in hightraffic healthcare environments.
- Helps in ICU and emergency care units where constant attention is critical.

2. Home Healthcare and Remote Patient Monitoring

- Enables safe IV administration at home for elderly or post-operative patients.
- Alerts caregivers or family members via smartphone notifications.
- Ideal for rural or remote areas with limited medical personnel.

3. Mobile Health Units and Ambulances

- Ensures saline therapy is monitored during transit.

4. Smart Hospitals and IoT-Based Healthcare Systems

- Can be integrated into hospital management software for real-time dashboards.
- Forms a part of the broader Internet of Medical Things (IoMT) ecosystem.
- Supports data logging and analytics for resource planning and incident tracking.

5. Nursing Training and Medical Education

- Used as a training tool for students to understand automation in patient care.
- Demonstrates the practical implementation of IoT in medical applications.

Advantages:

- **Real-time monitoring** with instant alerts.
- **Low cost** and easy to install in hospitals or home care setups.
- **Scalable and wireless**, suitable for monitoring multiple patients simultaneously.
- Reduces the need for **manual observation**, minimizing human error.
- Ensures **patient safety** by preventing saline depletion.

V. CONCLUSION

In this paper, an IoT-based automated saline level monitoring and alert system has been proposed and designed using a NodeMCU microcontroller and ultrasonic sensor. The system addresses a critical challenge in hospital and home care settings—unattended saline bottles running dry, which can lead to severe medical complications. By continuously monitoring the saline level and providing real-time alerts through both local indicators and Wi-Fi- based notifications, the system ensures timely intervention by medical staff or caregivers.

The use of NodeMCU allows seamless wireless communication, making the solution cost-effective, scalable, and easy to integrate into modern smart healthcare infrastructures. This approach not only reduces the burden on nurses and attendants but also enhances patient safety by minimizing human errors and delays.

Overall, the proposed system demonstrates how the integration of IoT and microcontroller technologies can significantly improve traditional healthcare processes.

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