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IoT-Integrated Smart Saline Management and Wearable Health Monitoring System for Real-Time Patient Safety

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ABSTRACT: The proposed system aims to enhance patient safety and reducing manual workload in hospitals through the use of **IoT (Internet of Things)** technology. The **Smart Saline Monitoring System** is designed to automatically detect the saline level in bottles using appropriate sensors. When the saline level becomes low or the bottle is empty, the system sends a **real-time alert notification** to the **nurse's or doctor's mobile application**. Additionally, it can automatically **stop the saline flow**, preventing the entry of air into the patient's bloodstream—an issue that can be dangerous and often occurs due to delayed manual monitoring.

This automation reduces the need for constant manual checking of saline bottles, minimizes **human errors**, and improves the efficiency of hospital staff.

In addition to saline monitoring, a **Smart Bandage** is proposed to continuously track a patient's **body temperature, pulse rate, and wound condition**. This data is sent wirelessly to medical staff for real-time analysis and response. The system is built using components such as the **NodeMCU microcontroller** and **various sensors**, making it **affordable**, **compact**, and **easy to use**.

Overall, the system ensures **real-time monitoring**, provides **timely alerts**, enhances **patient safety**, and supports **efficient healthcare management** through the integration of IoT technology.

KEYWORDS: IoT, Smart Healthcare, Saline Monitoring, NodeMCU, Smart Bandage, Real-Time Monitoring, Patient Safety, Automation, Healthcare Technology.

I. INTRODUCTION

In hospitals, continuous monitoring of saline bottles and patient health is essential to ensure safety and effective treatment. Manual observation of saline levels can lead to delays, human errors, and serious risks such as air entering the patient's bloodstream when the bottle becomes empty. Due to increasing workload on medical staff, constant supervision is not always practical.

To address this problem, the proposed system uses **IoT technology** to develop a **smart saline monitoring system** that automatically detects saline levels and sends real-time alerts to nurses or doctors when the level is low or empty. The system can also stop the saline flow automatically to prevent complications. Additionally, a **smart bandage** is introduced to monitor vital parameters such as temperature, pulse rate, and wound condition. By using a **NodeMCU**

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microcontroller and low-cost sensors, the system improves patient safety, reduces manual effort, and enables efficient real-time healthcare monitoring.

II. RESEARCH GAP

Although several healthcare monitoring systems and IoT-based medical solutions have been proposed in recent years, **significant gaps still exist** in their practical implementation and integration. Most existing saline monitoring methods rely heavily on **manual observation**, which is time-consuming and prone to human error. Some automated systems focus only on **saline level detection** but do not provide **automatic flow control**, increasing the risk of air embolism when the bottle becomes empty.

Additionally, many existing solutions operate as **standalone systems** and lack **real-time IoT-based alert mechanisms** that directly notify nurses or doctors through mobile applications. There is also limited integration between **saline monitoring** and **continuous patient health monitoring** within a single system. Current smart bandage or wearable solutions often monitor only one parameter and are expensive, complex, or unsuitable for low-resource healthcare environments.

Therefore, there is a clear research gap in developing a **cost-effective, integrated, and IoT-enabled system** that combines **automatic saline level monitoring, flow control, real-time alerts, and smart bandage-based vital sign monitoring**. Addressing this gap can significantly improve patient safety, reduce healthcare staff workload, and support efficient and reliable healthcare management in hospitals.

III. PROBLEM STATEMENT

In hospitals, saline bottles are usually monitored manually, which can lead to delays and human errors due to heavy workload on medical staff. Failure to replace an empty saline bottle on time may cause serious risks such as air entering the patient's bloodstream. Additionally, patient vital signs are not always monitored continuously. Hence, there is a need for a low-cost IoT-based system that can automatically monitor saline levels, control saline flow, send real-time alerts, and track patient health parameters to improve safety and healthcare efficiency.

IV. OBJECTIVES

- To design and develop an IoT-based smart saline monitoring system for hospital use.
- To automatically detect the saline level and identify low or empty saline bottles.
- To send real-time alert notifications to nurses or doctors through a mobile application.
- To automatically stop the saline flow when the bottle becomes empty to prevent air entry.
- To develop a smart bandage for monitoring patient parameters such as temperature, pulse rate, and wound condition.
- To reduce manual monitoring, human errors, and workload of healthcare staff.
- To improve patient safety and ensure efficient healthcare management using low-cost electronic components.

V. METHODOLOGY

- The proposed system follows an IoT-based methodology to provide real-time monitoring and improved patient safety. The system mainly consists of two modules: a **smart saline monitoring module** and a **smart bandage health monitoring module**, both controlled by a **NodeMCU microcontroller**.
- When the system is powered on, the NodeMCU initializes all sensors and establishes a Wi-Fi connection. The saline level sensor continuously monitors the saline bottle. The sensed data is compared with predefined threshold values. If the saline level is normal, the system continues monitoring. When the saline level becomes low or empty, an alert notification is sent to the nurse or doctor through a mobile application. Simultaneously, the system activates a control mechanism to automatically stop the saline flow, preventing air from entering the patient's bloodstream.
- In parallel, the smart bandage monitors patient parameters such as body temperature, pulse rate, and wound condition. The collected data is transmitted to the NodeMCU and uploaded to an IoT platform for real-time observation. Any abnormal readings trigger alerts for timely medical response.

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- Overall, the methodology ensures continuous monitoring, automatic control, and real-time communication using low-cost components, making the system reliable and suitable for hospital healthcare applications.

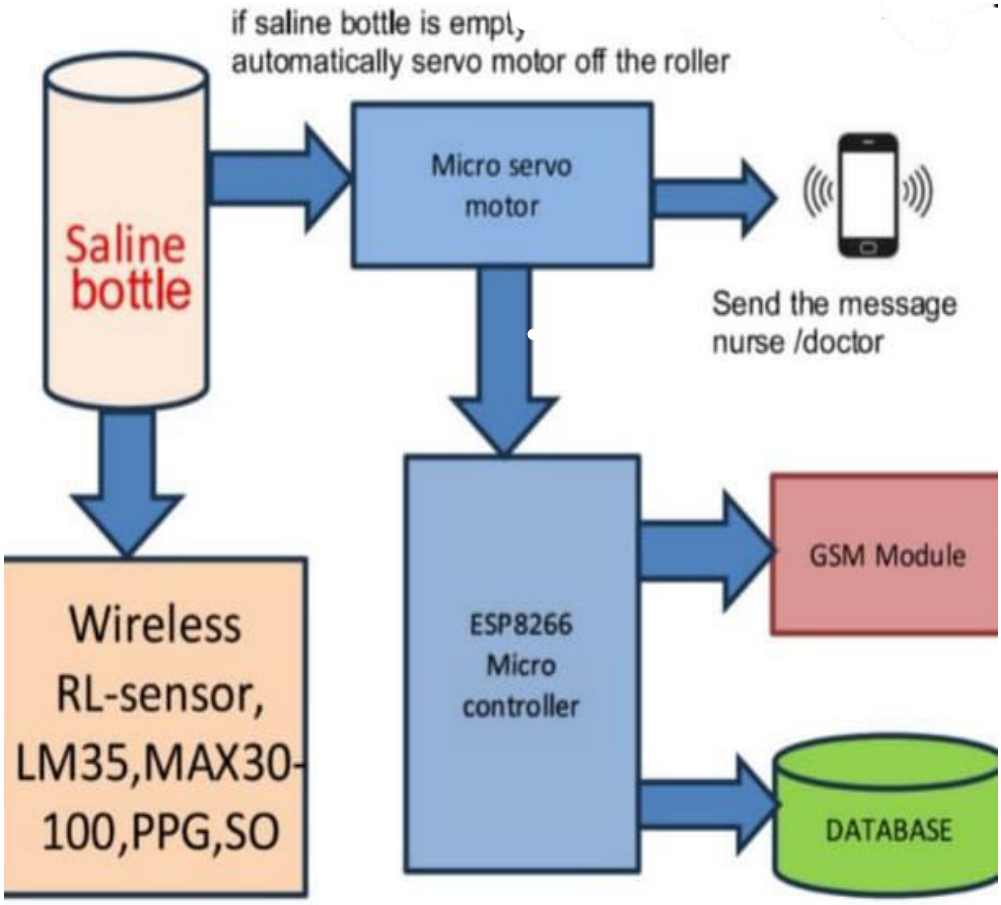

Fig. 1 Block Diagram of IoT-Based Smart Saline Monitoring and Health Monitoring System

VI. WORKING

The smart saline monitoring and smart bandage system works by integrating IoT technology with simple electronic sensors and a microcontroller to ensure continuous patient monitoring and safety. When the system is powered on, the **NodeMCU microcontroller** initializes all the connected sensors, including the saline level sensor, temperature sensor, pulse sensor, and wound monitoring sensor.

The saline level sensor continuously monitors the amount of saline present in the bottle. The collected data is processed by the NodeMCU and compared with a predefined threshold value. If the saline level is normal, the system continues monitoring without interruption. When the saline level drops below the set limit or becomes empty, the system immediately sends a **real-time alert notification** to the nurse or doctor through a mobile application using Wi-Fi connectivity. At the same time, a control signal is sent to a valve or motor mechanism to **automatically stop the saline flow**, preventing air from entering the patient's bloodstream.

Simultaneously, the **smart bandage** monitors patient parameters such as body temperature, pulse rate, and wound condition. These values are continuously transmitted to the IoT platform for real-time observation. If any abnormal condition is detected, the system alerts the medical staff, enabling quick medical intervention.

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Overall, the system operates continuously, providing real-time monitoring, automatic control, and instant alerts. This reduces manual effort, minimizes human error, and significantly improves patient safety and healthcare efficiency in hospital environments.

Advantages

- Improves patient safety by preventing air entry when the saline bottle becomes empty.
- Provides real-time monitoring and instant alerts to nurses and doctors.
- Reduces the need for constant manual checking of saline bottles.
- Minimizes human errors and delays in saline replacement.
- Automatically controls saline flow, ensuring safe intravenous therapy.
- Enables continuous monitoring of patient health parameters through the smart bandage.
- Low-cost and affordable system using simple electronic components.
- Easy to install, operate, and maintain in hospital environments.
- Enhances efficiency and reduces workload of healthcare staff.

Applications

- Hospitals for continuous saline level and patient monitoring.
- Intensive Care Units (ICUs) for critical patient safety and real-time alerts.
- Emergency wards to prevent delays in saline replacement.
- General wards to reduce nurse workload and manual monitoring.
- Clinics and nursing homes for efficient patient care.
- Home healthcare systems for remote patient monitoring.
- Elderly care centers for continuous health supervision.
- Smart healthcare and IoT-based medical monitoring systems.

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Future Scope

The proposed smart saline monitoring and smart bandage system can be further enhanced and expanded in several ways. Advanced sensors can be integrated to improve accuracy and to monitor additional patient parameters such as blood pressure, oxygen saturation (SpO_2), and ECG signals. The system can be connected to cloud platforms and hospital management systems for centralized data storage, analysis, and long-term patient health tracking.

In the future, artificial intelligence and data analytics can be applied to predict saline usage patterns and detect abnormal health conditions at an early stage. Mobile applications can be enhanced with detailed dashboards, history logs, and automated emergency alerts. The system can also be made more compact and wearable, improving patient comfort and usability. With further development and large-scale implementation, this system has the potential to become a reliable component of smart hospitals and remote healthcare monitoring solutions.

VIII. CONCLUSION

The IoT-based smart saline monitoring and smart bandage system provides an efficient solution for improving patient safety and healthcare management. By automatically monitoring saline levels, sending real-time alerts, and stopping

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saline flow when the bottle is empty, the system helps prevent critical medical risks and reduces dependence on manual supervision. The integration of a smart bandage for monitoring vital parameters such as temperature, pulse rate, and wound condition enables continuous patient monitoring and timely medical response.

The use of NodeMCU and low-cost sensors makes the system affordable, reliable, and easy to implement in hospital environments. Overall, the proposed system reduces human errors, lowers the workload of healthcare staff, and supports the development of smart and efficient healthcare systems.

REFERENCES

1. https://www.ijraset.com/research-paper/real-time-iot-based-saline-monitoring-system-for-healthcare-applications
P. Sravani et al. – *Real-Time IoT Based Saline Monitoring* (2025) (IJRASET)
2. https://jazindia.com/index.php/jaz/article/view/4736
Mr. Rajesh et al. – *IoT-Based Patient Health Monitoring System* (2024) (Jaz India)
3. https://www.ijert.org/iot-based-patient-health-monitoring-system-2
Prachi Patil et al. – *IoT Based Patient Health Monitoring System* (2021) (IJERT)
4. https://www.ijraset.com/research-paper/review-iot-based-health-monitoring-system
Deepak Saini et al. – *IoT Based Health Monitoring System* (2024) (IJRASET)
5. https://sciencepubco.com/index.php/IJET/article/view/10986
B. Naga Malleswari et al. – *Smart Saline Level Monitoring System Using IoT* (2018) (Science Publishing Corporation)

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