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# Real-Time IOT-Based Saline Monitoring System for Healthcare Applications

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***Abstract: This project introduces an IoT-based saline level monitoring system aimed at enhancing patient safety and improving healthcare efficiency. Traditional saline administration relies on manual or semi-automated monitoring, which can lead to human errors, delays in intervention, and risks such as over-infusion, under-infusion, and blood backflow. To address these challenges, the proposed system utilizes a NodeMCU (ESP8266), a load cell, and the Blynk app for continuous real-time monitoring. When the saline level drops below a preset threshold, the system triggers a buzzer to alert caregivers and automatically activates a solenoid lock to cut off the saline flow, preventing complications like infections and ineffective treatment. This automated approach minimizes the need for manual supervision, reduces response times, and ensures timely intervention, making it a reliable solution for modern healthcare settings. The integration of IoT technology enhances remote monitoring capabilities, streamlines patient care, and improves overall medical efficiency.***
***Keywords: IoT, Saline Monitoring, NodeMCU, Load Cell, Blynk App, Healthcare Automation, Patient Safety, Real-Time Alerts, Solenoid Lock, Remote Monitoring, Smart Healthcare.***

## I. INTRODUCTION

Intravenous (IV) saline administration is a critical process in healthcare, ensuring proper hydration and medication delivery to patients. Traditionally, saline levels are monitored manually by healthcare professionals, requiring frequent checks to prevent complications such as over-infusion, under-infusion, or blood backflow. However, this manual approach is time-consuming, prone to human errors, and may lead to delays in critical situations, potentially endangering patient safety. Semi-automated systems offer limited assistance with basic alarms but still require constant human supervision, making them inefficient in busy medical environments.

With advancements in the Internet of Things (IoT), automated saline monitoring systems can significantly enhance patient safety and streamline healthcare operations. The proposed IoT-based saline monitoring system utilizes a NodeMCU (ESP8266), a load cell, and the Blynk app to provide real-time saline level tracking and automated intervention. When the saline level drops below a predefined threshold, a buzzer alerts caregivers, and a solenoid lock automatically stops the flow to prevent over-infusion and blood backflow. This eliminates the risk of delayed responses and ensures timely medical attention.

By integrating IoT technology, this system enables remote monitoring through a mobile application, allowing medical staff to oversee multiple patients efficiently. The automated features reduce the burden on healthcare professionals, minimize human errors, and improve patient outcomes. This smart solution not only enhances safety but also optimizes resource utilization in hospitals and clinics, making it a valuable addition to modern healthcare infrastructure.

## II. EXISTING SYSTEM

The existing saline administration system primarily relies on manual monitoring by healthcare professionals, requiring frequent checks to prevent over-infusion, under-infusion, and blood backflow. This manual approach is time-consuming, prone to human errors, and may result in delayed responses, potentially compromising patient safety. Some healthcare facilities use semi-automated systems with basic alarms that notify caregivers when saline levels are low, but these systems still require manual intervention and lack remote monitoring capabilities. The absence of real-time automation increases the risk of unnoticed saline depletion, leading to serious medical complications. Given these limitations, there is a need for an advanced saline monitoring system that provides real-time alerts and automated control to enhance patient safety and streamline the saline administration process.

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## III. PROPOSED SYSTEM

The proposed system is an IoT-based saline level monitoring solution designed to enhance patient safety and improve healthcare efficiency. It utilizes a NodeMCU (ESP8266), a load cell, and the Blynk app to continuously monitor the saline level in real time. When the saline level drops below a predefined threshold, the system triggers a buzzer to alert caregivers and automatically engages a solenoid lock to cut off the saline flow, preventing over-infusion and blood backflow. This automation reduces the need for manual monitoring, minimizes human errors, and ensures timely intervention. Additionally, the integration of IoT technology enables remote monitoring through a mobile application, allowing healthcare professionals to oversee multiple patients efficiently. By combining real-time alerts, automated control, and remote accessibility, this system significantly enhances patient safety and optimizes the saline administration process in medical settings.

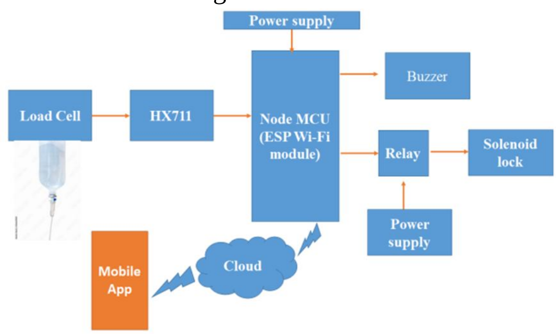


Fig.1. General Block diagram

## IV. COMPONENTS USED AND DESCRIPTION

### A. Arduino Uno

The ESP-12E module, which houses the ESP8266 chip with Tensilica Xtensa 32-bit LX106 RISC CPU, is included with the NodeMCU ESP8266 development board. This microprocessor runs at a configurable clock frequency of 80MHz to 160MHz and supports RTOS. To store information and applications, the NodeMCU features 4MB of Flash memory and 128 KB of RAM. It is perfect for Internet of Things applications because of its powerful processing capacity, built-in Wi-Fi and Bluetooth, and Deep Sleep Operating capabilities.

Fig.2. ESP8266 NodeMCU

### B. Power Supply

The system requires a regulated power supply to ensure proper functioning of the Arduino Uno and other components. Typically, a 5V or 9V DC power source (such as an adapter or battery) is used to supply stable power to the microcontroller and connected modules.

### C. Solenoid lock

Solenoid locks allow us to automate the operation of the latch by means of a voltage, in contrast to traditional door locks that need a key to pull or push the latch. The latch of a solenoid lock is pulled back into the door whenever an interrupt (such as a pushbutton or relay) is engaged. The solenoid operates on low voltage. There will be no change to the latch's position until the interrupt is turned on. The solenoid lock requires 12V to operate. 9V is another option, however it will cause the device to run more slowly. In order to automate processes that do not require human intervention, solenoid door locks are mostly utilised in distant places.

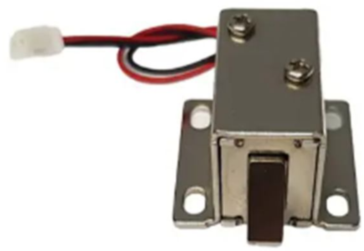

Fig.3. Arduino uno ATmega328p

*D. HX711*

To connect load cells to an Arduino, you may utilise the HX711 module, which is an amplifier for load cells. The HX711 module takes the weak signal from the load cell and makes it digital so the microcontroller can read it. You may determine the load cell's weight or force using the digital signal. Many different types of load cells, including strain gauge load cells, are compatible with the HX711 module.

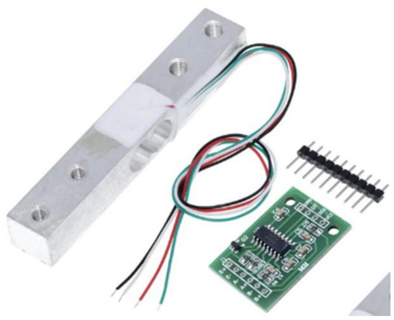

Fig.4. DHT11

*E. Buzzer*

A buzzer is used to provide audio feedback for system notifications. It sounds an alert when an order is placed, a payment is completed, or when a customer presses the waiter call button. This feature ensures staff members are immediately notified, reducing response time and enhancing service quality.


Fig.6. Buzzer

*F. Mobile App*

The Blynk App is used for real-time remote monitoring and alerts in the IoT-based saline monitoring system. It allows caregivers to track saline levels, receive instant notifications, and take necessary actions promptly.

## V. WORKING PROCESS

The proposed system operates based on the following step-by-step process:

*1) Saline Level Measurement*

The system uses a load cell, which is connected to an HX711 module, to measure the weight of the saline bottle. The weight data is continuously monitored to determine the remaining saline level. This information is then sent to the NodeMCU (ESP8266) microcontroller for further processing.

*2) Data Processing & Transmission*

The NodeMCU processes the received data and determines if the saline level is within a safe range. If the level is critically low, the microcontroller triggers necessary alerts. The processed data is then transmitted to the Blynk App via Wi-Fi, allowing caregivers to monitor the saline level remotely in real-time.

*3) Threshold Detection*

A predefined threshold is set in the system to identify when the saline level is dangerously low. If the saline bottle's weight falls below this threshold, the system detects the condition as critical. The NodeMCU then activates alert mechanisms to notify medical staff immediately.

*4) Alert Mechanism*

Once a low saline level is detected, the system triggers an audio buzzer to alert nearby caregivers. The buzzer ensures that medical staff can quickly attend to the situation and replace the saline bottle. Additionally, a notification is sent through the Blynk App, ensuring that remote caregivers are also informed.

*5) Automatic Flow Control*

If no immediate action is taken by the caregiver, the system engages a solenoid valve to automatically stop the saline flow. This prevents over-infusion and reduces the risk of blood backflow into the IV line, which could cause infections or complications. The automated cutoff ensures patient safety even in cases of delayed response.

*6) Remote Monitoring & Notification*

The Blynk App continuously updates caregivers with real-time saline levels, reducing the need for manual monitoring. Notifications are sent when the saline reaches a low level, providing medical staff with instant updates. This feature allows healthcare professionals to monitor multiple patients efficiently, improving response times and overall patient care.

## VI. RESULTS

The implementation of the IoT-based saline monitoring system demonstrated significant improvements in patient safety and healthcare efficiency. The system successfully monitored the saline level in real time using the load cell and transmitted data to the Blynk app. Caregivers were able to track saline levels remotely and received instant alerts when the fluid level dropped below the preset threshold. The automatic buzzer notification ensured that hospital staff could respond promptly, reducing the chances of under-infusion or over-infusion.The solenoid valve mechanism effectively prevented blood backflow and over-infusion by automatically stopping the saline flow when necessary. This feature proved to be highly beneficial in preventing complications such as infections and ineffective treatment. Additionally, the remote monitoring capability of the system allowed healthcare professionals to manage multiple patients efficiently, minimizing the need for frequent manual checks. The integration of IoT technology not only reduced human errors but also improved the overall quality of saline administration in clinical settings.

Overall, the results confirmed that the proposed system enhances patient safety, reduces workload for healthcare professionals, and optimizes the saline infusion process. The combination of real-time monitoring, automated alerts, and remote access makes this system a valuable addition to modern medical care, addressing the limitations of traditional saline monitoring methods.

Fig.11. Implementation Result

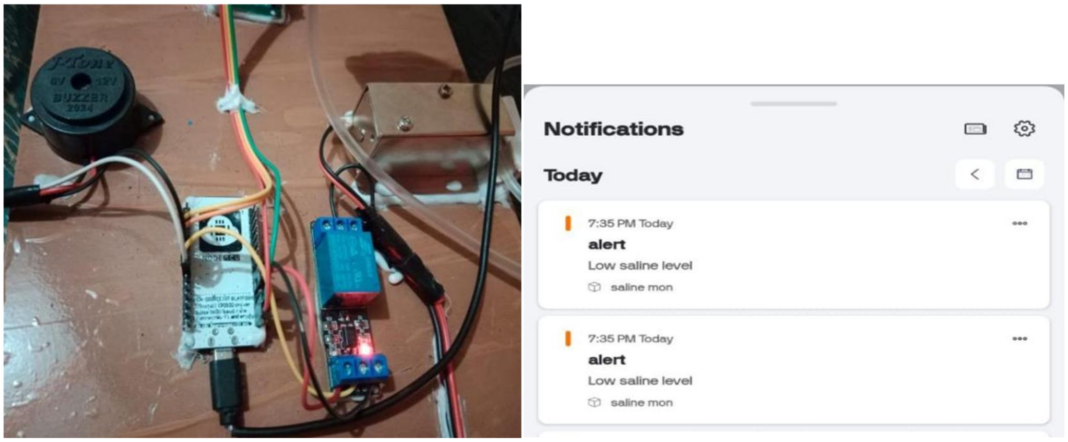


Fig.12. work status

## VII. CONCLUSION

The IoT-based saline monitoring system provides an efficient, automated solution for ensuring safe and accurate saline administration in healthcare settings. By integrating NodeMCU, a load cell, the Blynk app, a buzzer, and a solenoid valve, the system effectively monitors saline levels, provides real-time alerts, and prevents risks like over-infusion and blood backflow. The remote monitoring capability reduces the need for manual checks, enhancing caregiver efficiency and patient safety. Overall, this system offers a cost-effective, reliable, and user-friendly approach to improving saline infusion management in hospitals and clinics.

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