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IOT IV Bag Monitoring and Termination System Using Blynk IOT for Real Time Monitoring

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Abstract: ***This project proposes the development of an IoT-based IV Bag Monitoring and Termination or Alert System to enhance patient safety and reduce manual workload on healthcare staff. In hospitals, intravenous (IV) fluid levels are traditionally monitored by nurses through periodic manual checks, which can sometimes lead to delays in replacing empty IV bottles due to work pressure or human error. Such delays may cause serious complications for patients.***
The proposed system continuously monitors the IV fluid level using appropriate sensors and processes the data in real time through an IoT-enabled platform. When the fluid level reaches a predefined threshold (preset limit or reference value), the system automatically generates alerts to notify medical staff, ensuring timely replacement of the IV bag. The system aims to improve efficiency, minimize human intervention, and enhance reliability in patient care by providing an automated, real-time monitoring.

I. INTRODUCTION

Intravenous (IV) fluid therapy is widely used in hospitals to deliver fluids and medications to patients. Traditionally, IV bottles are monitored manually by nurses, which may lead to delays in replacement due to workload or human error. Failure to change the IV bottle on time can cause serious risks to patient safety. To address this issue, an IoT-based IV Bag Monitoring and Alert System is proposed. The system continuously monitors the IV fluid level using sensors and automatically sends alerts when the fluid reaches a predefined threshold. This ensures timely intervention, reduces manual effort, and enhances patient safety through reliable and real-time monitoring.Intravenous (IV) fluid therapy is widely used in hospitals to deliver fluids, electrolytes, and medications directly into a patient's bloodstream. It is essential in surgeries, emergency care, pediatrics, and general ward treatments. Traditionally, IV bottles are monitored manually by nurses, who must periodically check the remaining fluid level. However, due to high workload, staff shortages, or human error, IV bottles may not be replaced on time. This can lead to serious complications such as air entry into the veins, blood backflow, or interruption of critical medication delivery.

II. LITERATURE SURVEY

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III. PROBLEM FORMULATION

In hospitals, IV fluid levels are usually monitored manually by nurses, which can be difficult during busy working hours and high patient loads. Due to delayed observation, an IV bag may become empty without timely replacement, leading to problems such as interruption of medication delivery, blood backflow, and the risk of air embolism, which can endanger patient safety. The absence of a real-time monitoring system increases the chances of human error and adds to the workload of healthcare staff. Therefore, there is a need for an automated solution that can continuously monitor the IV fluid level and provide timely alerts before the IV bag becomes empty. The proposed IoT-based IV Bag Monitoring and Alert System addresses this issue by using sensors and IoT technology to track fluid levels in real time and notify medical staff when the fluid reaches a critical level, thereby improving patient safety, reducing manual effort, and ensuring uninterrupted treatment.

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IV. OBJECTIVES OF THE PROJECTS

1) To automatically monitor the IV fluid level without manual checking.
2) To provide real-time notifications to nurses through the Blynk IoT application and send email alerts when the IV fluid level reaches a critical level or the IV bottle is about to finish.
3) To prevent health risks by ensuring the IV bag is replaced on time.
4) To provide continuous and reliable monitoring of IV bags in hospital wards.
5) To improve patient safety and reduce the workload of healthcare staff.

V. METHODOLOGY OF PROPOSED WORK

A. *System Architecture*

The IoT-Based IV Bag Monitoring and Termination System uses a load cell and HX711 sensor module to measure the IV fluid level. The sensed data is processed by the ESP32 microcontroller and sent to the Blynk Cloud through Wi-Fi. Nurses can monitor the IV status in real time using the Blynk IoT mobile app. When the IV fluid level becomes low, the system sends a Blynk notification, an email alert, and activates a buzzer and LED to warn healthcare staff. This helps ensure timely replacement of the IV bottle and improves patient safety.

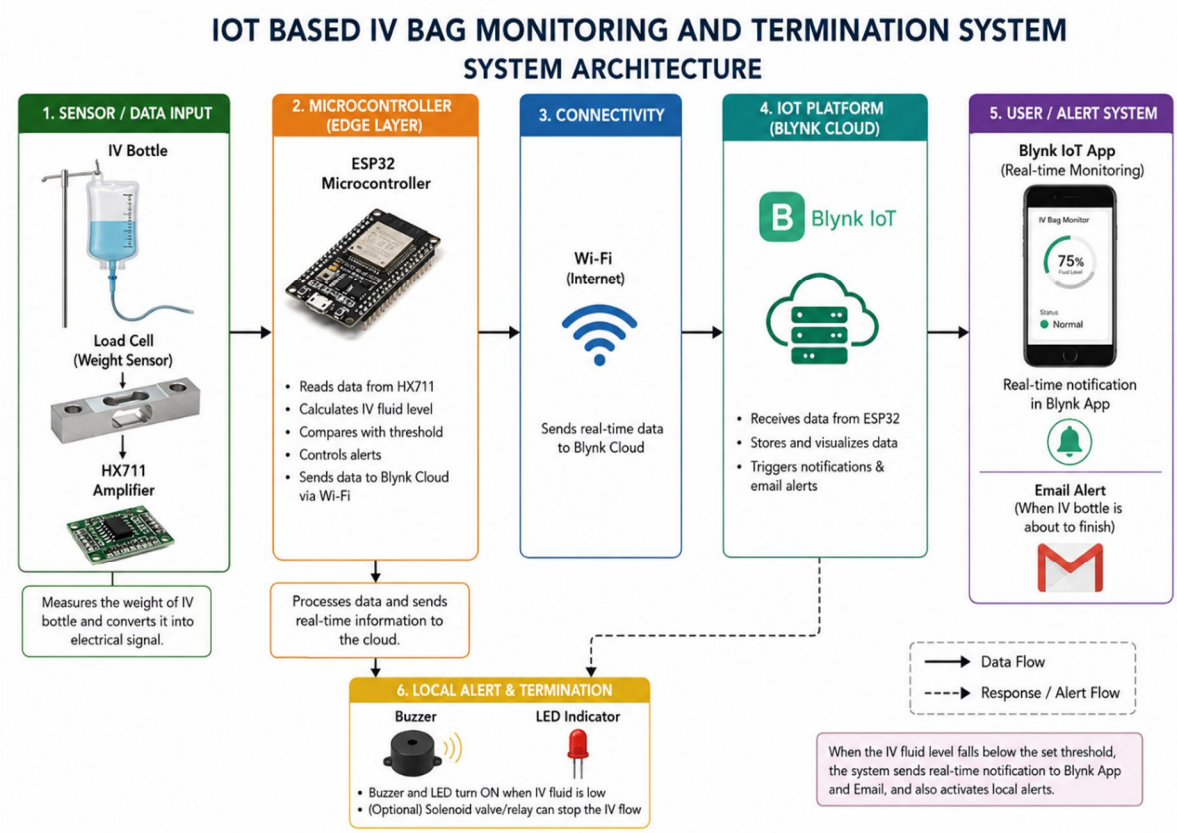

Fig : System Architecture

B. *Block Diagram*

The IoT-Based IV Bag Monitoring and Termination System consists of a Load Cell Sensor, HX711 Amplifier, ESP32 Microcontroller, Wi-Fi Module, Blynk Cloud, and Alert System. The load cell continuously measures the weight of the IV bottle, and the HX711 amplifier converts the sensor output into digital data. The ESP32 processes this data and calculates the remaining IV fluid level. Through Wi-Fi, the ESP32 sends the data to the Blynk Cloud for real-time monitoring. Nurses can view the IV status using the Blynk IoT mobile application. When the IV fluid level falls below the preset threshold, the system sends a real-time notification in the Blynk app, an email alert, and activates a buzzer and LED indicator. This ensures timely replacement of the IV bottle, reduces manual monitoring, and improves patient safety.

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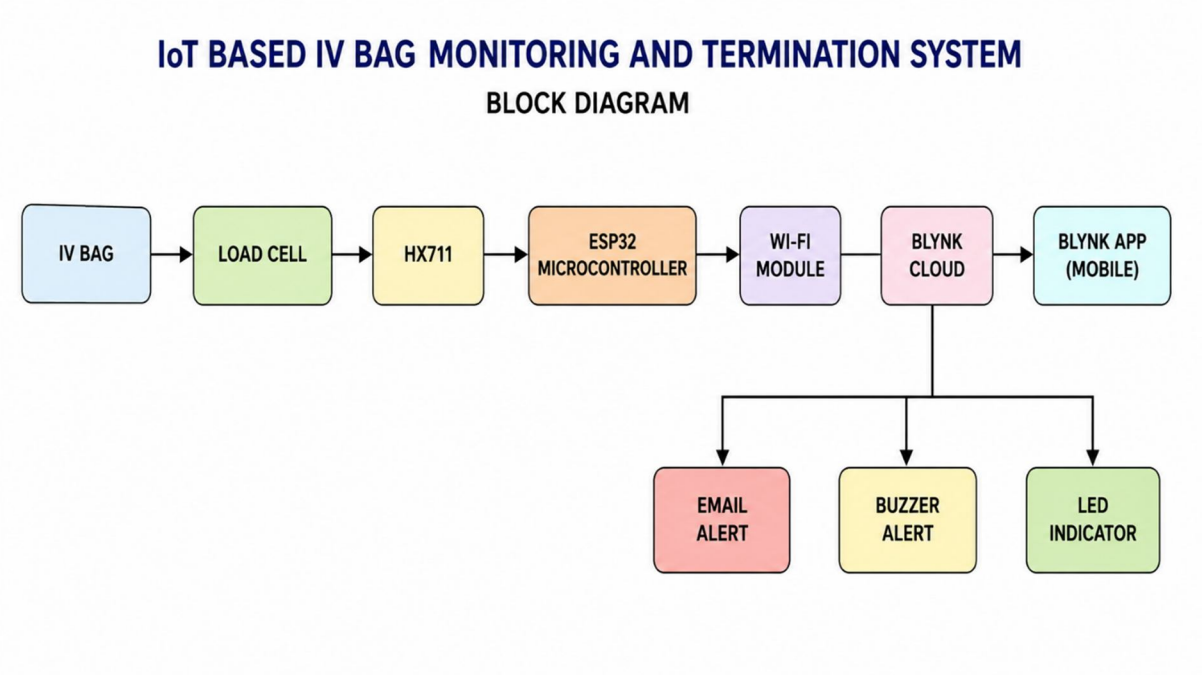

Fig 2:Block Diagram of IOT IV bag Monitoring

C. Flow Chart

The flow chart of the IoT-Based IV Bag Monitoring and Termination System starts when the system is powered ON. The load cell continuously measures the weight of the IV bag, and the HX711 module converts the sensor signal into digital data. The ESP32 microcontroller reads this data and calculates the remaining IV fluid level. The calculated value is then sent to the Blynk Cloud through Wi-Fi for real-time monitoring. The system checks whether the fluid level is above the preset threshold. If the fluid level is normal, monitoring continues continuously. If the fluid level falls below the threshold, the ESP32 activates the buzzer and LED indicator, sends a notification through the Blynk IoT application, and generates an email alert to notify nurses or caregivers. After the IV bag is replaced, the system resumes normal monitoring.

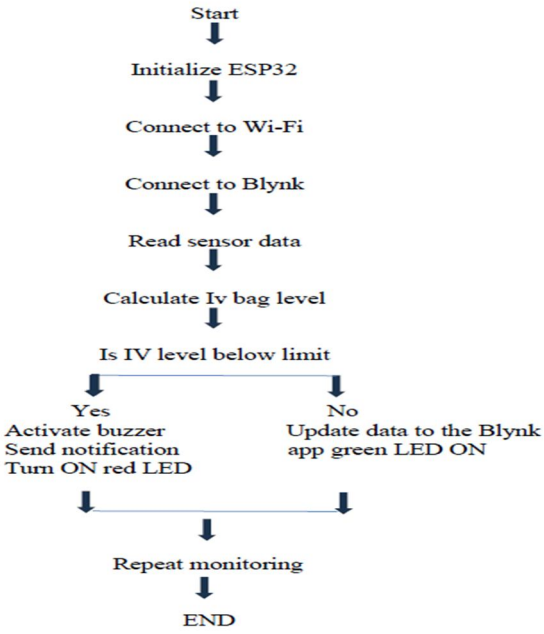

Fig 3: Flow Chart of IOT IV bag Monitoring

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D. Working Procedure and Observation Table

The IoT IV Bag Monitoring and Termination System uses an ESP32 microcontroller to continuously monitor the IV fluid level using a sensor (ultrasonic or load-cell based). After power-up, the ESP32 connects to the Wi-Fi network and the Blynk cloud platform. The sensor data is read periodically and processed to calculate the remaining IV fluid level. The calculated level is compared with a predefined threshold value. If the IV fluid level falls below the limit, the system activates a buzzer and red LED and sends a notification to medical staff through the Blynk application. If the fluid level is above the threshold, the system updates the status on the Blynk dashboard and keeps the green LED ON. The monitoring process repeats continuously, ensuring real-time supervision of IV bags and timely alerts for replacement.

Parameter	Component Used	Observed Value / Action	Output / Display
System Initialization	ESP32 Microcontroller	Power ON and system initialization performed	System ready, LEDs blink / startup confirmation
Wi-Fi Connection	ESP32 Wi-Fi Module	Connects to available Wi-Fi network	Wi-Fi connected indicator (LED or log)
Blynk Connectivity	Blynk IoT Platform	Establishes connection with Blynk server	Blynk app connected and ready for data
Sensor Data Reading	Ultrasonic / Load Cell Sensor	Reads fluid level data from IV bag sensor	Raw sensor data acquired
IV Level Calculation	ESP32 Processing Unit	Calculates remaining IV fluid level	IV level value computed (%) or ml
Threshold Check	Embedded Logic (ESP32)	Compares IV level with preset limit	Decision: Below limit / Above limit
Alert Activation (If Below Limit)	Buzzer, Red LED	Activates local alerts when level is below limit	Buzzer ON, Red LED ON, alert generated
Notification to Staff	Blynk App / IoT Notification	Sends alert/notification to nurses or staff	Push notification / Alert on Blynk app
Data Update (If Above Limit)	Blynk App / Green LED	Updates normal status to Blynk app when level is adequate	Green LED ON, status displayed on Blynk app
Continuous Monitoring	ESP32 Main Loop	Repeats sensing, processing, and updates continuously	Real-time monitoring and status updates

Table I: Observation Table

VI. HARDWARE AND SOFTWARE REQUIREMENTS

A. Hardware Requirements

The IoT IV Bag Monitoring and Termination System requires an ESP32 microcontroller as the main processing unit. A load cell sensor is used to measure the weight of the IV bag, and an HX711 amplifier module converts the sensor output into digital data. The system also includes LED indicators and a buzzer for visual and audio alerts. A stable Wi-Fi network is required for communication with the Blynk cloud platform. A personal computer or laptop is used for programming, testing, and monitoring the system.

B. Software Requirements

The system is developed using the Arduino IDE for programming the ESP32 microcontroller. The Blynk IoT platform is used for cloud connectivity, remote monitoring, and notification services. The system utilizes ESP32 Wi-Fi libraries for wireless communication and HX711 libraries for sensor data acquisition. The Blynk mobile application provides a user-friendly interface for monitoring IV fluid levels and receiving alert notifications in real time.

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C. Cost Analysis

Component	Cost (₹)
ESP32 Microcontroller	₹450
Load Cell Sensor	₹250
HX711 Amplifier Module	₹120
Buzzer	₹30
LEDs and Resistors	₹50
Breadboard	₹70
IV Bag (500 ml)	₹60
Jumper Wires & Miscellaneous Components	₹100
Total	**₹1130**

Table II: Cost Analysis

VII. DESIGN AND IMPLEMENTATIONS

A. System Initialization and Sensor Data Collection

The IoT IV Bag Monitoring and Termination System begins by powering ON the ESP32 microcontroller and establishing a Wi-Fi connection. The ESP32 is then connected to the Blynk cloud platform for remote monitoring. Sensors and output devices are initialized to ensure proper operation. The load cell continuously measures the weight of the IV bag, while the HX711 module converts the analog sensor signals into digital values for processing.

B. IV Fluid Level Monitoring and Decision Making

The ESP32 processes the sensor data and calculates the remaining IV fluid level. The measured value is compared with a predefined threshold level. If the IV fluid level remains above the threshold, the system continues monitoring and updates the status on the Blynk application. If the fluid level falls below the threshold, the system proceeds to the alert stage to notify healthcare staff.

C. Alert Generation and Notification System

When the IV fluid level becomes critically low, the system activates a buzzer and turns ON the red LED to provide an immediate alert. Notification messages are sent through the Blynk application, enabling doctors and nurses to receive real-time updates. These alerts help ensure timely replacement of the IV bag and improve patient safety.

D. Cloud Communication and User Interface

The system uploads real-time sensor data to the Blynk IoT platform through Wi-Fi communication. Healthcare professionals can remotely monitor the IV bag status using the Blynk dashboard. The user interface displays IV fluid levels and system status, allowing continuous monitoring and quick response when alerts are generated.

E. System Reliability and Continuous Monitoring

After an alert is generated, medical staff can replace the IV bag. The system then measures the IV fluid level again to confirm that the new IV bag is functioning properly. If the fluid level is restored above the threshold, normal monitoring resumes with the green LED indication. This continuous monitoring process ensures reliable operation and uninterrupted patient care.

VIII. RESULT AND DISCUSSION

A. Output Screenshots

The following screenshots illustrate the operation of the IoT-Based IV Bag Monitoring System. Fig. 4 shows the home page of the mobile application displaying the connected IV bag monitoring device and shows the monitoring dashboard displaying the IV fluid level in milliliters and percentage. Fig. 5 shows the notification page that alerts users when the IV bag level becomes low. Fig.6 show over all set up of the project.

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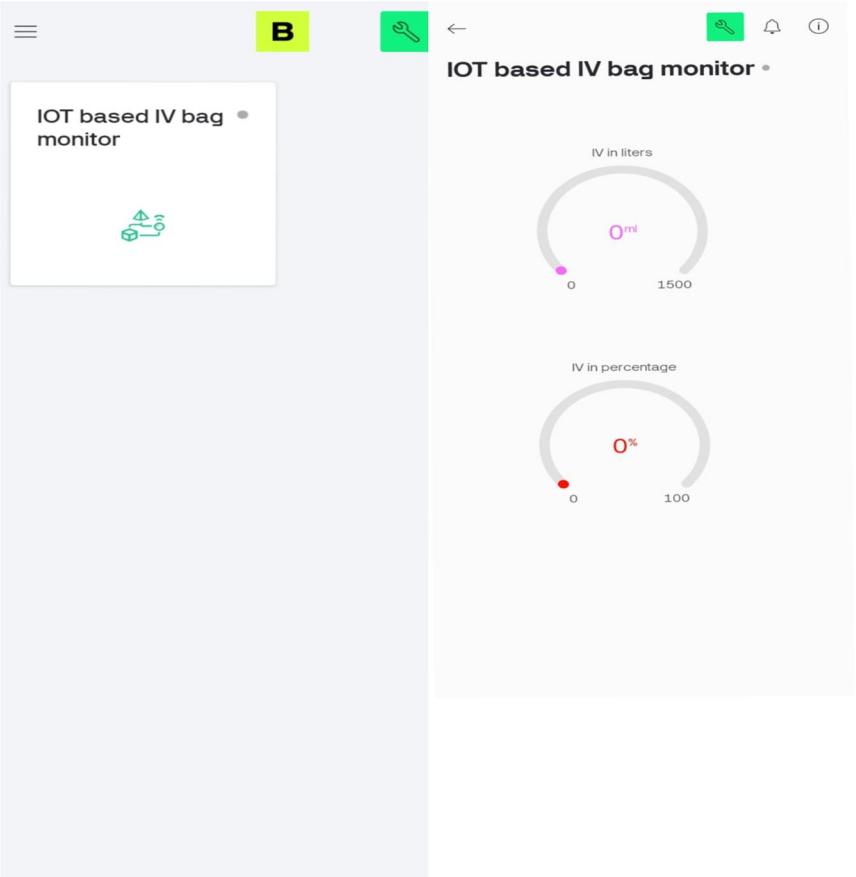

Fig.4: Home page and monitoring dashboard displaying the IV fluid level.

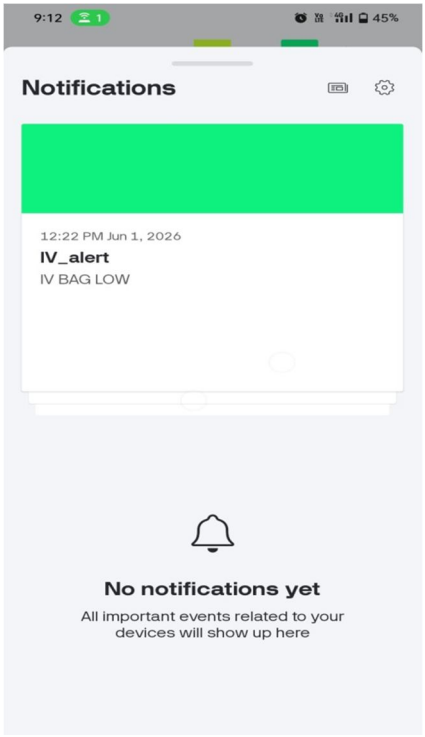

Fig.5:Notification pate alerts the user when the IV bag level is low

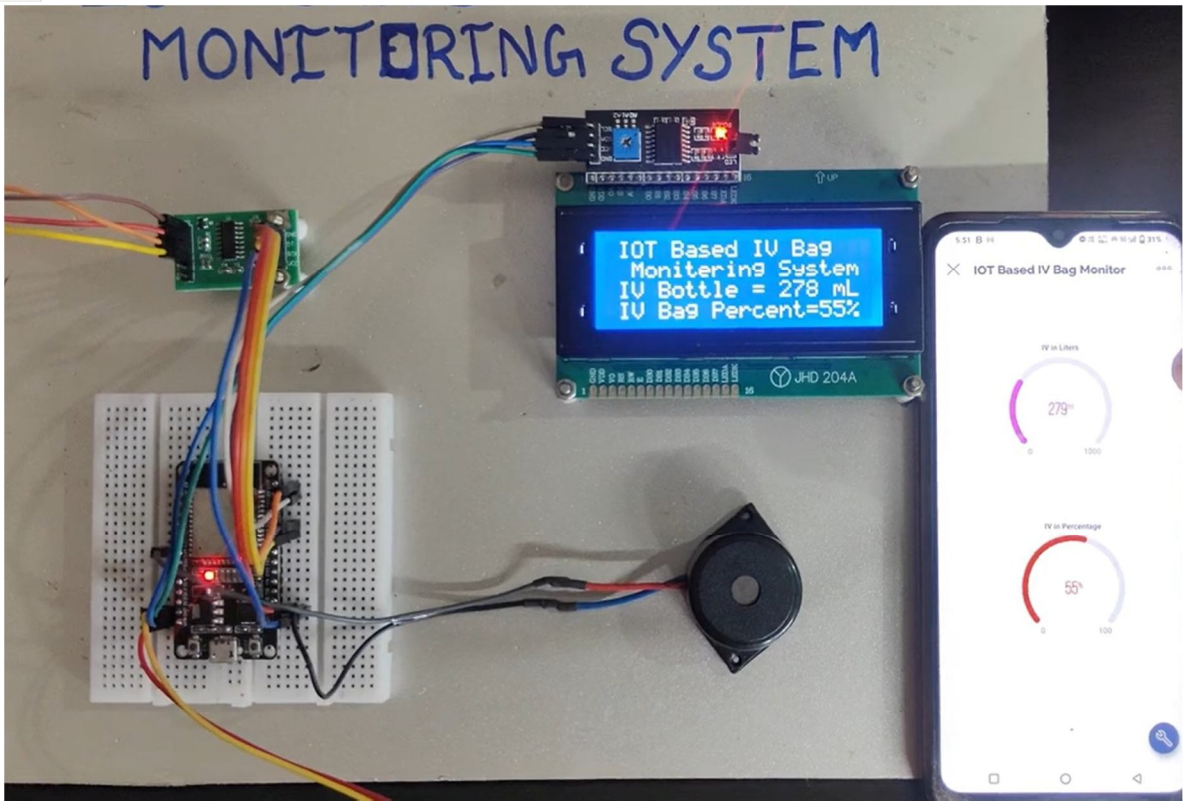

Fig.6: the overall set up of the project.

B. Real-Time Monitoring and Alert System

The developed IoT-based system successfully performs real-time monitoring of IV fluid levels. The load cell sensor continuously measures the weight of the IV bag and sends the data to the microcontroller. The measured values are processed and displayed on both the LCD screen and the mobile application. When the IV fluid level falls below a predefined threshold, the system automatically generates a notification and activates an alert mechanism, enabling timely replacement of the IV bag and reducing manual supervision.

C. IV Bag Monitoring Performance

The proposed system demonstrated reliable monitoring performance by accurately measuring the remaining IV fluid volume and calculating the corresponding percentage. The load cell sensor provided stable readings, while the IoT platform enabled continuous remote access to monitoring data. The system effectively detected low IV fluid conditions and generated instant alerts, improving patient safety and reducing the risk of fluid depletion during treatment.

D. System Performance and Efficiency

Key observations include fast sensor response, accurate fluid-level measurement, reliable wireless communication, and efficient cloud-based data storage. The mobile application provided a user-friendly interface for viewing IV fluid status and notifications. The system operated continuously with minimal delay, ensuring real-time monitoring and prompt alert generation.

E. Discussion

The results demonstrate the practical applicability of IoT technology in healthcare monitoring systems. The proposed IoT-Based IV Bag Monitoring System minimizes the need for continuous manual checking of IV fluid levels and helps healthcare professionals respond quickly to low-fluid conditions. The integration of sensors, wireless communication, cloud services, and mobile notifications enhances monitoring efficiency and patient care. Future improvements may include integration with hospital management systems, advanced analytics, and support for monitoring multiple IV bags simultaneously.

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IX. CONCLUSION

The proposed IV fluid monitoring system effectively addresses critical challenges in healthcare by enabling real-time level tracking and automated low-fluid detection. By triggering instant alerts via buzzer, LED, and mobile notifications, it ensures timely bag replacement by medical staff, thereby reducing manual monitoring efforts. This not only prevents risks such as blood backflow but also enhances overall patient safety and healthcare efficiency, making it a reliable solution for modern medical environments.

X. FUTURE WORK

1) Integration with hospital management systems for centralized monitoring
2) Development of a dedicated mobile application with enhanced remote access features.
3) Monitoring of multiple IV bags simultaneously through a single dashboard.
4) Implementation of SMS and emergency alert notifications for nurses and caregivers.
5) Deployment and testing of the system in real hospital environments for performance validation.
6) Development of automatic IV flow control mechanisms to prevent complete fluid depletion.

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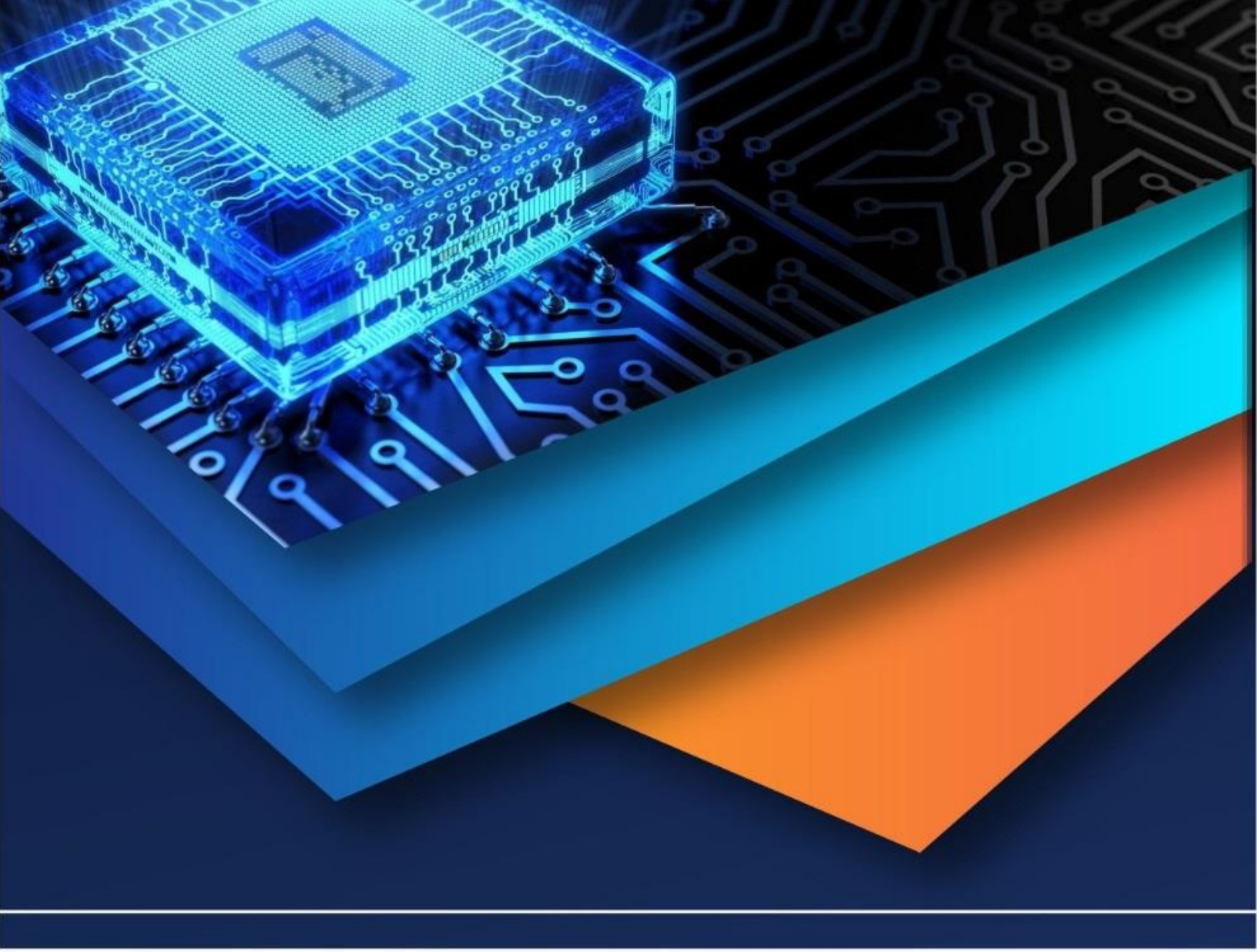

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