IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 12, Issue 2, April 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Refereed Journal |

|| Volume 12, Issue 2, April 2024 ||

International Conference on Recent Development in Engineering and Technology – ICRDET 24

Organized by

Dhaanish Ahmed Institute of Technology, KG Chavadi, Coimbatore, Tamilnadu, India

Smart Intravenous Fluid Monitoring System: Enhancing Patient Care with Real-Time Alerts

G. Nithya[1], M. Mohanapriyaa[2], I. Mohamed Jiyath Khan[3], P. Miraclin[4], SP. Sree Raya Perumal[5], K. Jayasri[6]

Assistant Professor, Dept. of Electronics and Communication Engineering, Adithya Institute of Technology, Coimbatore, Tamil Nadu, India[1,2].

UG Students, Dept. of Electronics and Communication Engineering, Adithya Institute of Technology, Coimbatore, Tamil Nadu, India[3,4,5,6].

ABSTRACT: Intravenous (IV) fluid administration is a critical aspect of patient care in healthcare settings, necessitating precise monitoring to prevent complications. This paper presents an Intravenous Fluid Level Monitoring and Alerting System designed to enhance the monitoring process. The system utilizes an array of components including ESP8266, Ultrasonic Sensor, Servo Motor, LCD Display, Green LED, LDR module, Buzzer, and a 5V Power Supply. Through real-time monitoring and alerting mechanisms, the system ensures timely interventions when IV fluid levels drop below a certain threshold, thereby improving patient safety and reducing the risk of adverse events.

KEYWORDS: Intravenous Fluid Monitoring, ESP8266, Ultrasonic Sensor, Alert System, Real-time Monitoring, Patient Safety.

I. INTRODUCTION

Intravenous (IV) fluid therapy is a cornerstone of medical treatment, providing patients with essential fluids, electrolytes, and medications directly into the bloodstream. However, inadequate monitoring of IV fluid levels can lead to adverse outcomes such as dehydration, electrolyte imbalances, and medication errors. Traditional methods of IV fluid monitoring rely heavily on manual observation by healthcare professionals, which may be prone to human error and oversight. To address these challenges, we propose an innovative Intravenous Fluid Level Monitoring and Alerting System aimed at enhancing the efficiency and accuracy of IV fluid management.

II. LITERATURE SURVEY

Previous research in the field of IV fluid monitoring has highlighted the importance of real-time monitoring systems in improving patient outcomes and reducing healthcare costs. Various approaches utilizing different sensors and communication technologies have been explored to develop automated IV fluid monitoring systems. However, few studies have focused on integrating advanced features such as alerting mechanisms and remote monitoring capabilities into these systems. Our proposed system aims to bridge this gap by incorporating a comprehensive set of features to ensure timely detection of IV fluid level deviations and prompt intervention when necessary.

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III. PROPOSED SYSTEM

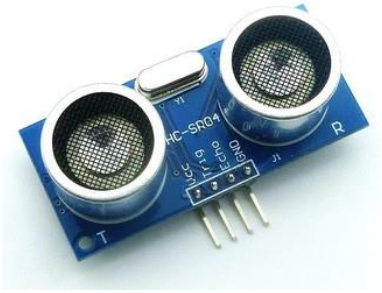
The proposed system consists of an array of components including ESP8266, Ultrasonic Sensor, Servo Motor, LCD Display, Green LED, LDR module, Buzzer, and a 5V Power Supply. The Ultrasonic Sensor is employed to measure the level of fluid in the IV bottle, while the Servo Motor is used to control the flow of fluid. Real-time data regarding the fluid level is displayed on the LCD Display, with alerts triggered when the fluid level drops below a predefined threshold. A web dashboard provides remote access to the monitoring system, allowing healthcare professionals to view the fluid level status and receive alerts in real-time.

IV. HARDWARE DESCRIPTION

The hardware components used in the system play a crucial role in ensuring accurate and reliable monitoring of IV fluid levels. The ESP8266 microcontroller facilitates wireless communication and data transmission, while the Ultrasonic Sensor enables precise measurement of fluid levels. The Servo Motor controls the flow of fluid, and the LCD Display provides visual feedback to users. Additionally, auxiliary components such as the Green LED, LDR module, and Buzzer enhance the alerting mechanism and improve user interaction.

ESP8266: The ESP8266 microcontroller serves as the core of the system, facilitating wireless communication and data transmission between components. It interfaces with sensors to collect real- time data on IV fluid levels and controls the servo motor for regulating fluid flow.

Ultrasonic Sensor: The Ultrasonic Sensor is utilized for accurate measurement of the fluid level in the IV bottle. It emits ultrasonic waves and measures the time taken for the waves to bounce back, providing precise distance measurements which are then used to determine the fluid level.



Servo Motor: The Servo Motor is responsible for controlling the flow of IV fluid. It adjusts the position of the valve to regulate the flow rate based on input from the ESP8266 microcontroller. This ensures precise and adjustable delivery of fluids to the patient

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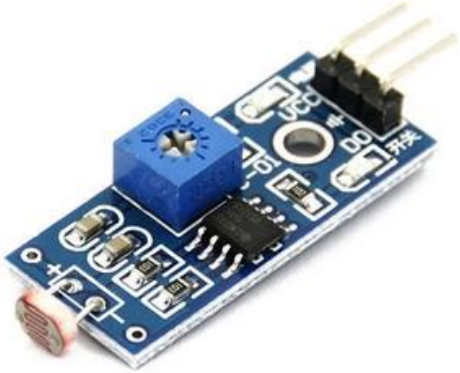
LCD Display with I2C: The LCD Display with I2C interface provides real-time feedback to users by displaying the current fluid level. It enhances user interaction by presenting clear and concise information, enabling healthcare professionals to monitor the IV fluid status at a glance.

Green LED: The Green LED serves as a visual indicator of system status. It can be programmed toindicate normal operation or specific events such as low fluid levels, providing additional feedback to users without relying solely on the LCD display.

LDR Module: The Light Dependent Resistor (LDR) module detects ambient light levels in the environment. It can be used to adjust the brightness of the LCD display or trigger alerts based on changes in lighting conditions, enhancing the system's adaptability to different environments also used to count drops.



Buzzer: The Buzzer is employed as an auditory alerting mechanism to notify healthcare professionals of critical events such as low fluid levels. It emits a distinct sound when triggered, ensuring that alerts are promptly noticed

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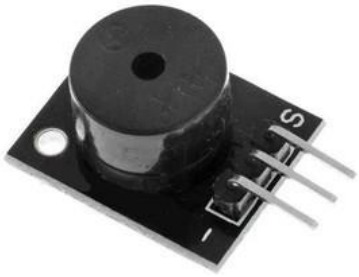


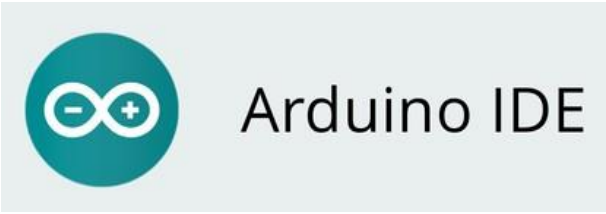
V. POWER SUPPLY:

The 5V Power Supply provides the necessary electrical power to all components of the system, ensuring continuous operation. It can be connected to mains power or battery sources depending on the deployment environment, ensuring flexibility and reliability.

VI. SOFTWARE DESCRIPTION

The software aspect of the system is implemented using the Arduino IDE and HTML web dashboard. Header files such as AsyncTCP.h and ESPAsyncWebServer.h are utilized for real-time data display and communication between the hardware components. The Arduino code is responsible for sensor data acquisition, alert generation, and servo motor control, while the web dashboard provides a user- friendly interface for remote monitoring and management of the IV fluid levels.

Arduino IDE: The Arduino Integrated Development Environment (IDE) is used for programming the ESP8266 microcontroller. It allows developers to write, compile, and upload code to the microcontroller, enabling the implementation of custom logic for sensor data processing, servo motor control, and alert generation.



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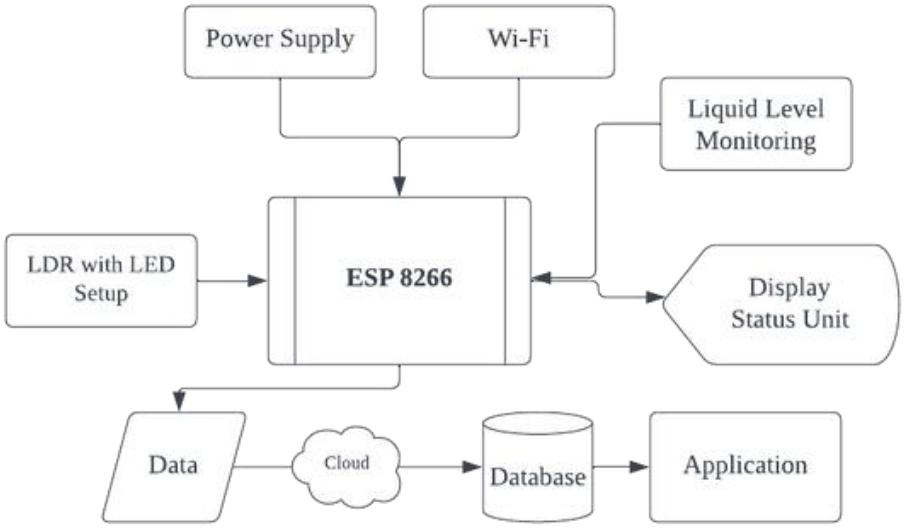
HTML Web Dashboard: The HTML web dashboard provides a user-friendly interface for remote monitoring and management of the IV fluid levels. It is designed using HTML, CSS, and JavaScript, and hosted on a web server accessible via the internet. The dashboard communicates with the ESP8266 microcontroller to retrieve real-time data and trigger alerts, providing healthcare professionals with insights into IV fluid status from anywhere with internet access.

I. Block Diagram



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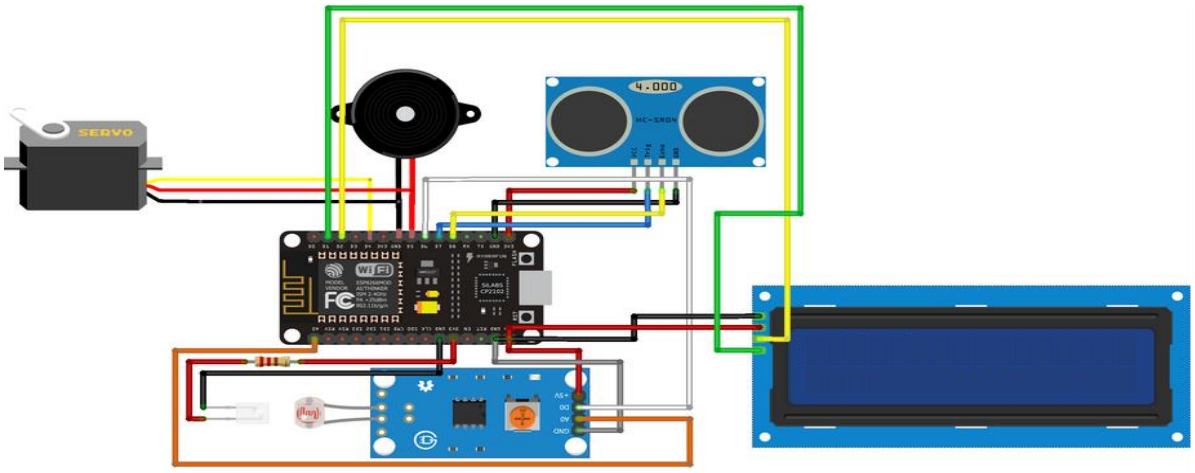
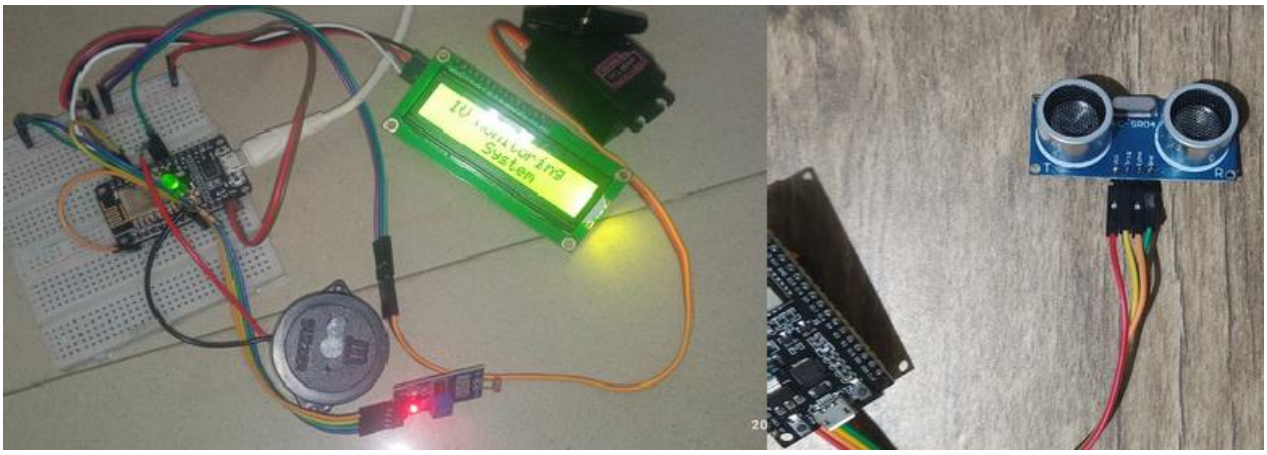
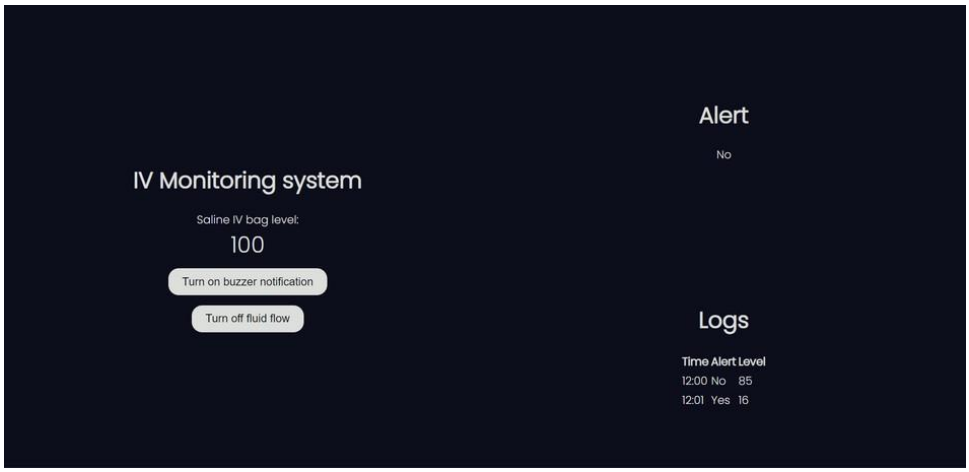
II. Circuit Diagram



III. Project Setup



IV. Web Dashboard



VII. CONCLUSION

In conclusion, the proposed Intravenous Fluid Level Monitoring and Alerting System offers a robust solution for enhancing IV fluid management in healthcare settings. By leveraging advanced hardware components and software technologies, the system enables real-time monitoring of IV fluid levels and timely intervention in case of deviations. The integration of remote monitoring capabilities further enhances the accessibility and usability of the system, making it a valuable tool for improving patient safety and quality of care.

Future Scope

Future enhancements to the system could include the integration of additional sensors for monitoring parameters such as temperature and pressure, thereby providing a more comprehensive view of IV fluid status. Moreover, the incorporation of machine learning algorithms could enable predictive analysis of IV fluid requirements based on patient characteristics and clinical data, further optimizing fluid management protocols. Additionally, interoperability with existing hospital information systems and electronic health records could facilitate seamless integration into clinical workflows, maximizing the impact of the system on patient care.

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