© May 2026 | IJIRT | Volume 12 Issue 12 | ISSN: 2349-6002

Automatic IV Drip Monitoring And Alert System

Mrs. S. Kanimozhi[1], S. Sowmiya[2], R. Kiruthika[3], S. Sowbarnika[4], S. Pradeepa[5]
[1]*Professor, Department of Biomedical Engineering, Sri Shanmugha College of Engineering and Technology Salem, India*
[2,3,4,5]*Department of Biomedical Engineering, Sri Shanmugha College of Engineering and Technology Salem, India*

***Abstract*—In hospitals, IV fluid is commonly given to patients for medicines, saline, blood, and nutrients. While giving IV fluid, the fluid level should be checked properly at the correct time. If the IV bottle becomes empty and nobody notices it, some problems may happen like blood coming back into the tube, stopping of medicine flow, or air entering the IV line. Usually, nurses check the IV bottle manually again and again. In busy hospitals, this becomes difficult because one nurse may take care of many patients at the same time. Due to this, sometimes the fluid level may not be noticed immediately. To solve this problem, this project is developed as an automatic IV Fluid Monitoring System. In this system, ESP32 is used as the main controller. A load cell sensor is connected to measure the weight of the IV bottle continuously. Since the sensor output is very small, the HX711 module is used to amplify the signal. The measured value is processed by the controller, and the remaining fluid level is calculated. All the readings are shown on the OLED display so that they can be seen easily. A buzzer is also connected in the system. When the fluid level becomes low, the buzzer gives an alert sound immediately. Because of this, the nurse or caretaker can replace the IV bottle quickly without delay. The system works continuously and helps in reducing manual checking work. This device is simple, low-cost, portable, and easy to use in hospitals or clinics. From this project, it is understood that automatic IV fluid monitoring can help in improving patient safety and making hospital monitoring easier.**

***Index Terms*—IV fluid monitoring, ESP32, load cell sensor, HX711 module, OLED display, buzzer alert system, automatic monitoring, healthcare system, fluid level detection, patient safety**

I.INTRODUCTION

IV bottles are used in hospitals for giving saline, glucose, blood, and medicines to patients. While the fluid is going into the patient's body, the bottle should not become empty. If the IV bottle becomes empty and no one notices it, problems may happen. Blood may come back into the tube and medicine flow may stop. Because of this, nurses need to check the IV bottle often.

Usually, in hospitals, nurses check the bottle manually by seeing the fluid level. In busy hospitals, one nurse may take care of many patients. During that time, checking every IV bottle again and again becomes difficult. Sometimes the bottle may become empty before changing it. This increases work for nurses and may affect patient care.

To avoid this problem, this project is developed as an IV Fluid Monitoring System. ESP32 is used as the main controller in this project. A load cell sensor is connected to measure the IV bottle weight. The sensor value is given to the HX711 module for amplification. Then the value is processed by the controller to find the remaining fluid level.

The output is displayed on the OLED screen. A buzzer is also connected in the system. When the fluid level becomes low, the buzzer gives an alert sound. By hearing the alert, the nurse or caretaker can replace the IV bottle quickly. Because of this, there is less need for continuous manual checking.

This system is simple and easy to use. It is also portable and low in cost. The project helps in reducing nurse workload and improving patient safety in hospitals and clinics.

II. LITERATURE REVIEW

IV fluid monitoring is very important in hospitals because the IV bottle should be checked properly during treatment. In many hospitals, nurses check the fluid level manually by seeing the bottle regularly. When there are many patients in the ward, checking every IV bottle again and again becomes difficult. Sometimes the bottle may become empty without notice. Because of this problem, many researchers started developing automatic IV fluid monitoring systems to make the work easier and safer.

Some earlier projects used simple electronic circuits and sensors to identify the IV fluid level. In those systems, an alarm was given when the fluid became low. These methods helped reduce manual checking work and made monitoring easier compared to normal observation methods. But many of those systems only gave basic indication and did not support continuous monitoring properly [3].

Later, researchers started using load cell sensors for IV fluid monitoring. In these systems, the weight of the IV bottle was measured continuously to find the remaining fluid quantity. Microcontrollers were used to process the sensor value and display the result. Some systems also included buzzers and display units for alert indication. Compared to manual checking, these methods provided better accuracy and helped nurses know the fluid condition more easily [4]. However, some setups required more components and proper calibration, which made the system slightly difficult to handle in small hospitals.

After that, IoT-based IV monitoring systems became more common. In those methods, the sensor readings were sent through Wi-Fi to mobile phones or webpages. This helped nurses and caretakers monitor patients from a distance without standing near the bed all the time. Some systems also sent warning messages when the IV fluid became low [5]. Even though these methods improved monitoring, internet connection was necessary for proper working, and this increased the cost of the system.

Some researchers also tried different types of sensors for fluid level detection. Ultrasonic sensors and infrared sensors were used in a few projects to identify the fluid level without touching the bottle directly. But sometimes the readings changed because of bottle shape, light conditions, or sensor position. Due to this, continuous accurate monitoring became difficult in certain situations [6].

From the literature survey, it is understood that many systems are already available for IV fluid monitoring, but some problems are still there. Some systems are costly, some depend fully on internet connection, and some only provide monitoring without proper alert support. Because of these drawbacks, this project is developed as a simple and low-cost IV Fluid Monitoring System using ESP32, load cell sensor, HX711 module, OLED display, and buzzer alert system. The system is easy to use and helps in reducing manual checking work while improving patient safety.

III. SYSTEM ARCHITECTURE AND METHODOLOGY

This project is made for checking the IV fluid level automatically. In hospitals, IV bottles are used for giving saline, medicines, blood, and nutrients to patients. Usually, nurses check the bottle manually to see whether the fluid is remaining or empty. In busy duty time, continuous checking becomes difficult because one nurse may take care of many patients. Sometimes the IV bottle may become empty without notice. To avoid this problem, this system is developed for automatic IV fluid monitoring.

In this project, the weight of the IV bottle is checked continuously using a load cell sensor. The measured value is processed by the controller to find the remaining fluid level. The reading is shown on the OLED display. When the fluid level becomes low, a buzzer gives an alert sound. The complete setup contains sensing, controlling, display, and alert sections.

A. Hardware

Different hardware components are connected in this setup. Each component has separate work, and all the parts work together for proper monitoring.

Control Unit

ESP32 is used as the main controller in this project. All sensor outputs are connected to this controller only. It reads the sensor value, processes the reading, calculates the fluid level, and controls the output devices. Display updating and buzzer control are also done by this controller. So, the total system working depends on ESP32.

Input Sensing Unit

The load cell sensor is the main sensing component used here. It is connected below the IV bottle arrangement for measuring the bottle weight continuously. Since the load cell output is very small,

HX711 module is connected with the sensor. This module amplifies the signal and sends the value to the controller.
Based on the measured weight, the remaining IV fluid quantity is identified. Continuous sensing helps in proper monitoring of the IV bottle condition.

Alert Unit
A buzzer is connected as the alert unit in this setup. When the IV fluid level becomes low, the controller activates the buzzer automatically. Because of this alert sound, the nurse or caretaker can know immediately that the bottle needs to be changed.

Display Unit
OLED display is used for showing the output values directly. It displays the IV bottle weight, fluid percentage, and monitoring condition. Messages like normal condition, low fluid warning, and emergency indication are also shown on the display.

Power Supply
A regulated DC power supply is given to all modules. Since the controller, sensor, and display need proper voltage, stable power supply is necessary for continuous working.

Advantages of Hardware Design
- No need for repeated manual checking
- Simple and easy to use
- Continuous IV fluid monitoring
- Immediate alert indication
- Portable and low-cost setup
- Useful for hospitals and clinics

Because of these features, the system becomes more useful for patient monitoring.

B. Block Diagram
The load cell sensor is the initial sensor input unit used in this project. It monitors the IV bottle weight; the output is sent to the HX711 module for amplification, and then to the ESP32 controller for final processing.
The ESP32 controller processes the output from the load cell sensor in determining how much fluid remains in the IV bottle. The ESP32 displays the remaining volume of fluid on the OLED display. The ESP32 controller is programmed to monitor low or empty fluid levels. If the remaining volume of fluid drops below a pre-set level, an audible alarm is activated via a buzzer, alerting the medical staff to low or empty fluid levels.
Both the load cell sensor, the HX711 module, and the ESP32 controller are capable of performing constant and simultaneous functions that consist of: 1) sensing the weight of an IV bottle for the purpose of measuring IV fluid volume; 2) monitoring the weight of the IV bottle for the purpose of determining how much fluid remains in an IV bottle; and 3) generating an audible alarm when the weight of the IV bottle drops below a specified threshold.
Furthermore, the ESP32 module offers significant expansion possibility via its Wi-Fi compatible hardware, thus providing for the capability to remotely monitor the fluid status of an IV bottle via a mobile device or web browser.

Block Diagram

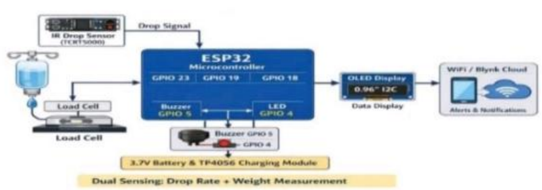

Fig 1: IV Fluid Monitoring System using ESP32 and Load Cell Sensor

C. Software Implementation and Data Processing
Arduino IDE software with Embedded C coding is used in this project. The program is written for checking the sensor values continuously and updating the outputs repeatedly.

Software Implementation
When the power supply is switched ON, all modules are initialized first. After that, the ESP32 controller starts reading the load cell value through the HX711 module.
The measured sensor value is processed continuously to calculate the remaining IV fluid quantity and percentage. Then the calculated values are displayed on the OLED screen. At the same time, the controller checks the fluid level condition continuously.

Data Processing
Inside the program, fixed fluid level limits are already set. The current fluid percentage is compared with those limits continuously.

If the fluid level is normal, monitoring continues normally. If the fluid level becomes low, the buzzer alert turns ON. When the bottle reaches emergency condition, continuous alert indication is given so that the IV bottle can be replaced immediately.

The sensor values are updated repeatedly for proper real-time monitoring.
Output Handling
Finally, the output is obtained in two forms.
One is OLED display output.
Second is buzzer alert indication.
So, this project provides both monitoring and alert support for IV fluid management.

IV. MATHEMATICAL CONCEPTS AND EQUATIONS

This project uses some simple calculations for checking the IV bottle condition.

1. Bottle Weight
The load cell checks the weight of the IV bottle.

$$W = m \times g$$

Were,
W=bottle weight
m= mass of fluid
g= gravity
This is used for measuring the IV bottle weight.

2. Remaining Fluid
The remaining fluid percentage is calculated from the bottle weight.

$$P = \frac{W_r}{W_f} \times 100$$

Were,
P= remaining fluid percentage
W_r= remaining weight
W_f= full bottle weight
This calculation shows how much fluid is remaining inside the bottle.

3. Fluid Quantity
The fluid amount is identified using the measured weight.

$$V = \frac{W}{D}$$

Were,
V= fluid quantity
W= measured weight
D= density of fluid
This helps in finding the approximate fluid amount.

4. Buzzer Alert
The buzzer works when the fluid level becomes low.

$$P \leq P_t$$

Were,
P= current fluid percentage
P_t= fixed limit value
When the fluid percentage becomes lower than the limit, the buzzer turns ON.

5. Reading Update The sensor readings are updated continuously after fixed timing.

$$T_u = n \times t_s$$

Were,
T_u= update time
n= cycle count
t_s= sampling time
This is used for continuous monitoring in the system.

V. PROTOTYPE IMPLEMENTATION AND CHALLENGES

Prototype Implementation

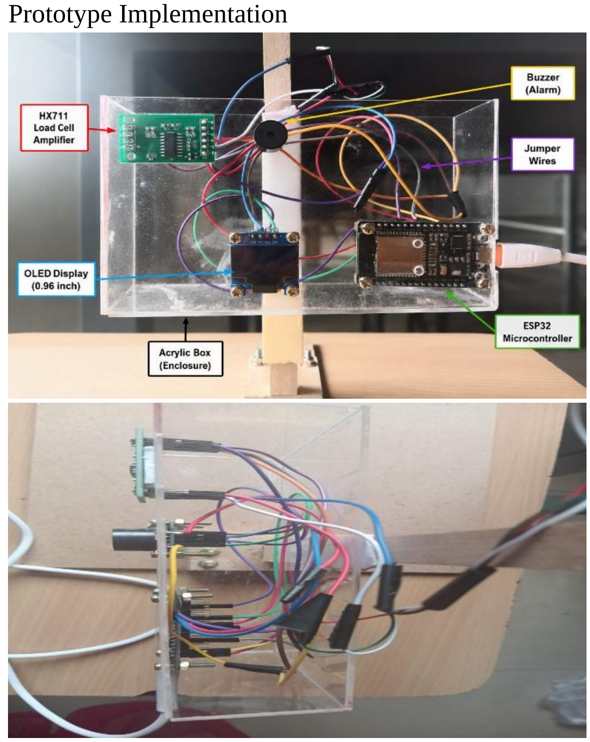

Fig 2: Hardware Components of the IV Fluid Monitoring System Prototype

In this project, a prototype model was developed for checking the IV fluid level automatically. The main aim of developing this model is to reduce manual checking work in hospitals and help nurses monitor IV bottles more easily.

The complete setup is made using ESP32 controller and different electronic components. In this project, the load cell sensor is used as the main sensing component. Along with that, HX711 module, OLED display, and buzzer are connected in the setup.

The load cell sensor is placed below the IV bottle arrangement for measuring the bottle weight continuously. Since the sensor gives a very small signal, the HX711 module is used to amplify the value before sending it to the controller. Based on the measured weight, the remaining fluid level inside the IV bottle is identified.

All the readings are taken by the ESP32 controller. After processing the values, the output is shown on the OLED display. The display shows the bottle weight, remaining fluid percentage, and monitoring condition. A buzzer is also connected in the prototype as an alert system. When the IV fluid level becomes low, the controller turns ON the buzzer automatically. Because of this alert sound, the nurse or caretaker can know that the bottle needs to be replaced.

After connecting and testing all the modules, the prototype was able to monitor the IV bottle continuously without problem. The system was also able to provide proper alert indication when the fluid level became low. From the testing, it is understood that IV fluid monitoring can be done in a simple and low-cost way using this setup.

Challenges Faced

When checking load cell readings for stability, there is an inconsistency between output and input if you move the IV bag. Because of this, we need to reposition the sensor to achieve the same output as before.

Because of the difficulty in checking connections due to all the wires used in setup, there have been a number of times where loose connections caused the output not to work.

At the beginning there was no buzzer indicating fluid level on, but after changing the code to test there is a working buzzer indicating fluid level.

In the beginning the power supply wasn't stable enough to power up the OLED display causing the display to blink, once the wiring was done correctly the display started functioning normally.

VI.RESULT AND DISCUSSION

Case 1:

During testing, the prototype was capable of continuously monitoring the IV fluid level. This was the main result of the project. A load cell sensor was used to measure the weight of the IV bottle and then calculate the amount of fluid left in it. In addition to monitoring the fluid level, this system also provided continuous real-time monitoring of the condition of the IV bottle. All of these values were indicated on an OLED or LCD display.

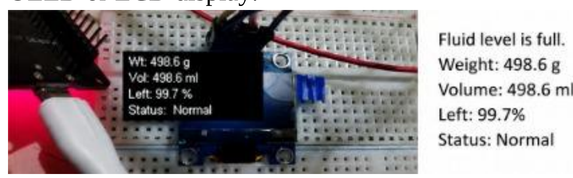

Figure 3: Output of IV Fluid Monitoring System 1

Case 2:

Figure 4: Output of IV Fluid Monitoring System 2

At this point, the IV fluid levels had decreased compared to the previous test. The continuously displayed weight of the IV bottle and percentage of remaining fluid were monitored as the fluid in the IV bottle reduced gradually. The system continuously tracked the amount of fluid left in real time.

Case3:

Figure 5: Output of IV Fluid Monitoring System 3

When the fluid in the IV bottle was at a very low level, the buzzer alert was sounded. This was a warning that the IV bottle must be Immediately replaced. The display also indicated the low fluid condition with a warning status.

All of the above readings were processed continuously using the ESP32 controller, allowing the IV bottle condition to be monitored without manual inspection. The Mari Iantha 3 case Ku image kudu lcd display la kudu different values ah 500 below values in lcd display

Technical Issues

During the course of this project, we encountered some minor technical difficulties during testing, but they did not prevent the system from functioning. An example of this was the issues we had with the load cell sensor reading where sometimes it would continuously read the same weight value. This issue occurred because the weight reading changed with a very minor movement of the IV bag, and thus, the position of the load cell sensor had to be positioned properly in order to get a clear reading.

Another issue was with the power supply. The power supply for this project is the ESP32, load cell, OLED display, and buzzer, and these devices all require a regulated power supply in order to work correctly. When the power supply was not connected correctly to the load cell, the OLED display, and the buzzer, an intermittent output from the load cell sensor would result from the intermittent power to it. Once we provided a regulated power supply, the system worked much better.

The buzzer alert also gave us some minor issues during the initial phases of operation, as it sometimes turned on before the IV fluid had reached the specified fluid level. We ultimately fixed the threshold value that defined how much fluid was in the IV bag in the program that controls the buzzer alert.

Although the OLED display was small, it had enough space on it to clearly display all the main values used to monitor the IV bag. We were able to continuously monitor the level of the IV fluid and provide proper alarm alerts after we corrected all of these issues.

VII. CONCLUSION

This project demonstrates a simplified way of monitoring IV fluid levels that does not require constant manual monitoring. The load cell sensor continuously measures the weight of the IV bottle to determine the exact amount of IV fluid left. Therefore, both nurses and caregivers can easily know how much IV fluid is left in an IV bottle.

The system incorporates a load cell sensor, an HX711 module, an ESP32 microcontroller, a buzzer, and an OLED display to continuously measure the IV fluid level and alert for low fluid levels. The OLED display indicates the current IV fluid level, and when a certain preprogrammed amount of fluid remains in the IV bottle, the buzzer will sound an alert that indicates it's time to replace the IV bottle, thus increasing patient safety.

The entire assembly is low-cost, lightweight, and easy to carry. This project illustrates how IV fluid monitoring can be achieved simply, easily, and reliably with this system.

REFERENCE

[1] Kumar and Prakash, "An automatic IV fluid monitoring system based on load cells and microcontrollers," *International Journal of Innovative Research in Science and Engineering*, 2021.

[2] Ramesh *et al*., "An intelligent IV saline monitoring and alert system using ESP32," *International Journal of Advanced Research in Engineering and Technology*, 2022.

[3] Sharma *et al*., "IoT-based monitoring system to provide better IV fluids for patients in hospitals," in *Proc. Int. Conf. Healthcare Informatics and Medical Systems*, 2022.

[4] Reddy *et al*., "Automatic saline bottle monitoring system using load cell and buzzer alarm," *International Journal of Engineering Research and Applications*, 2021.

[5] Joseph *et al*., "Wireless IV fluid level monitoring system using ESP32 and OLED display," in *Proc. Int. Conf. Smart Healthcare Technologies*, 2022.

[6] Harish *et al*., "Real-time IV bottle monitoring and alert system for hospital applications," *Journal of Embedded Systems and Applications*, 2022.

[7] Rajesh *et al*., "Design and implementation of an intelligent IV-fluids monitoring system," in *Proc. Annual Conf. Healthcare Informatics and Medical Systems*, 2023.

[8] S. R. K., A. Deepan Raj, P. R. M., V. Vignesh Kumar, K. B., and M. V., "Use of load cell sensors in real-time monitoring of IV fluid levels," in *Proc. Int. Conf. Smart Health Care and Embedded Systems*, 2024, pp. 102–107.

[9] A. J. Sayyad, V. P. M. B. Aarthi, S. K. R. Panga, V. S. Thumma Uru, S. Dinakaran, and A. K., "Smart infusion monitoring using ESP32 with

cloud integration," in *Proc. Int. Conf. Next Generation IoT and Embedded Systems*, 2023, pp. 201–206.

[10] V. M., U. K., V. M., A. S., and G. P., "Wearable and non-invasive patient monitoring for IV drip/fluid tracking," in *Proc. Int. Conf. Intelligent Technologies for Sustainable Medical Systems*, 2023, pp. 55–60.

[11] R. K., S. Praveen Kumar, M. Raghul, A. Dinesh, and V. Karthik, "IoT-based IV drip monitoring system using ESP32 and load cell sensor for real-time hospital applications," in *Proc. Int. Conf. Advanced Embedded Systems and Healthcare Technologies*, 2024, pp. 110–115.

[12] P. Kumar, S. Arun, R. Vignesh, and D. Mahesh, "Smart infusion monitoring system with buzzer alert and automatic fluid level detection for patient safety," in *Proc. Int. Conf. Intelligent Medical Devices and Automation*, 2023, pp. 88–92.

[13] N. Suresh, K. Deepak, M. Hari, and S. Ganesh, "Real-time IV fluid level monitoring system using microcontroller-based load cell integration and OLED display," in *Proc. Int. Conf. IoT and Biomedical Engineering*, 2023, pp. 140–145.