B. V. V. Sangha's

BASAVESHWAR ENGINEERING COLLEGE

BAGALKOTE - 587102

2024-25

DEPARTMENT OF ELECTRONICS AND COMMUINCATION ENGINEERING

MINI PROJECT [22UEC511P] REPORT ON

IoT BASED IV BAG MONITORING AND ALERT SYSTEM

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CERTIFICATE

This is to certify that the mini project report entitled **"IoT BASED IV BAG MONITORING AND ALERT SYSTEM"** submitted by **Soumya.V.Sankanagoudra [2BA22EC105], Soumya.H.Melligeri [2BA22EC104], Soundarya.R.Metagudd [2BA22EC106], Vijaylaxmi .L.Kudari [2BA22EC122]** studying in V semester during the year 2024-25 from Basaveshwar Engineering College, Bagalkote, in partial fulfilment for the award of degree **Bachelor of Engineering in Electronics and Communication Engineering** is a bonafide record work done by them under my supervision.

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Examiner	**Name of Examiner**	**Signature**
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Soumya H M

Soumya V S

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ABSTRACT:

In healthcare, ensuring the timely replacement of IV (intravenous) fluid bags is crucial to patient safety and treatment efficiency. Manual monitoring of IV fluid levels is prone to errors, leading to potential complications such as air embolism, delayed medication delivery, or dehydration. This project presents an IV Bag Monitoring and Alert System designed to automate the monitoring process.

The system employs sensors to continuously measure the fluid level in the IV bag and a microcontroller to process the data. When the fluid level approaches a predefined threshold, the system triggers an audible and visual alarm to alert medical staff. Additionally, the system can integrate with IoT platforms to send notifications to healthcare personnel via mobile or computer applications. This ensures timely intervention and enhances patient care quality.

The proposed system is cost-effective, user-friendly, and can be easily implemented in hospitals, clinics, and home care settings. By reducing the dependency on manual checks, it minimizes human error, optimizes resource utilization, and improves patient outcomes. This innovation represents a step toward smarter, safer healthcare solutions.

1 . INTRODUCTION:

The IV Bag Monitoring and Alerting System is an innovative healthcare technology designed to automate the monitoring of intravenous (IV) fluid levels, ensuring timely replacement and reducing the risks associated with empty IV bags. The system uses a load cell integrated with an HX711 module to measure the weight of the IV bag, which reflects the fluid level. A microcontroller processes the data and displays the real-time fluid status on an LCD screen for easy monitoring by healthcare staff. When the fluid level drops below a critical threshold, the system activates a buzzer to provide an audible alert, ensuring immediate attention. Additionally, IoT integration enhances the system's functionality by enabling remote monitoring through smartphones, computers, or centralized hospital management systems. This ensures real-time updates and notifications, allowing healthcare providers to act promptly even when not physically present. The system improves patient safety by preventing complications such as air embolism and backflow, which can occur if an IV bag runs dry. It also reduces the workload on healthcare workers, eliminating the need for constant manual monitoring, and allowing them to focus on more critical tasks. Designed for applications in hospitals, home care, and elderly care facilities, the IV Bag Monitoring and Alerting System is a reliable, scalable, and efficient solution that enhances the quality of care and streamlines healthcare operations.

1.1 PROBLEM STATEMENT :

Development an IV bag monitoring system can help to prevent these problems by continuosly monitoring the iv drip and alerting staff when necessary

MOTIVATION :

Monitoring IV bag is labour intensive , it can be difficult for staff to monitor IV bag regularly, especially in larger facilities or when there are limited staff. Nurse may forgot to change the IV bottle when it is empty,blood can flow backwards into the saline bottle when the saline is empty,Which can lead to decreased hemoglobin levels and tiredness .

1.2 OBJECTIVES:

1.Enhance Patient Safety:

Prevent risks such as air embolism or backflow caused by empty IV bags.Ensure uninterrupted IV fluid administration for patients.

2.Automate Monitoring:

Replace manual IV bag monitoring with a real-time automated system to improve efficiency.

3.Timely Alerts:

Notify healthcare staff immediately when fluid levels drop to a critical threshold through audible alarms or IoT-based notifications.

4.Improve Healthcare Efficiency:

Minimize the workload of medical staff, allowing them to focus on other essential tasks.

5.Reduce Human Errors:

Eliminate the chances of overlooking low IV fluid levels during manual checks.

6.IoT Integration:

Enable remote monitoring and notification capabilities through smartphones, centralized systems, or cloud platforms.

7.Data Logging and Analysis:

Provide real-time and historical data for monitoring fluid consumption patterns,in better inventory.

8.Cost-Effective Solution:

Develop a system that is affordable and scalable for use in hospitals, clinics, and home care environments.

9.Scalability for Different Scenarios:

Design the system to work in various healthcare setups, such as hospitals, nursing homes, ambulances, or home healthcare.

10.User-Friendly Interface:

Provide a simple and easy-to-understand system, including clear alerts and real-time displays for healthcare staff.

11.Customizable Alert Settings:

Allow adjustment of threshold levels and alert modes to suit different clinical requirements.

12.Portable Design:

Ensure the system is compact and lightweight, making it easy to integrate with existing IV stands or bedside setups.

13.Energy Efficiency:

Design the system to consume minimal power for prolonged usage in hospitals or homes.

14.Promote Technological Advancements:

Encourage the adoption of smart technologies in healthcare to improve service delivery and patient outcomes.

15.Enable Predictive Maintenance:

Use IoT and data analysis to predict when IV bags will need replacement, enhancing proactive care

2. LITERATURE SURVEY:

1. Ms. Sincy Joseph, Ms. Navya Francis Ms. Anju John, Ms. Binsi Farha Btech Students, Computer Science and Engineering Vimal Jyothi Engineering College Chemperi

This project aims at creating a device which will not only monitor but also control the drip rate and provide alarms when needed. This project aims at creating a device which will not only monitor but also control the drip rate and provide alarms when needed. The device will fulfil the following challenges by enabling easy adjustment of the drip rate for a given fluid or set of fluids, which you can simply enter as volume to be infusion, time at which it must be injected, drop factor and required droplet speed. To make it easier to access, the drop rate will be constantly monitored and reported. Regardless of changes in fluid concentration, composition, gravitation or the liquid content within the reservoir or other parameters, the drop shall continue to be constant. An alarm (audible and visual) will be triggered whenever the drip chamber becomes full, drip is stopped, variations in set rate (speeded up or slowed down), pre-set reservoir level reached, reservoir low or empty, battery low, etc. In order to avoid the occurrence of air embolisms and other complications, the drip will be interrupted automatically before the reservoir is filled or when a prior set level has been reached.

2. IoT based drips monitoring system in hospitals

Mrs.B. Kiruthiga1, Babithasri S2, Gayathri U3, Nandhini S4 Assistant Professor, Velammal College of Engineering and Technology, Madurai1 Department of EEE, Velammal College of Engineering and Technology, Madurai, India2-4

The term "The Internet of Things" refers to a network of physical objects including all appliances, cars, buildings and other structures that have been integrated with sensors, software or electronics enabling it to communicate and retrieve data from one another. The development of the Internet of things has been stimulated by a convergence of different technologies such as real time analytics, machine learning, commodity sensors and embedded systems.The nurse or members of the family should be closely monitoring patients every time they are injected with saline. Often, the nurse has forgotten to replace her saline container when it's entirely empty because of a busy schedule, inattention or an increased number of patients. Due to a difference in blood pressure and the pressure inside the empty saline container, blood returns to the saline bottle shortly after the saline has finished This would lead to the blood from their veins flowing backwards into a saline bottle. This may lead to decreased haemoglobin levels in the patients, and they can alsoexperience a lack of blood Red Cells RBCCs which causes them to become tired. Therefore, in order to reduce the patient's reliance on caregivers or nursing staff, it is necessary to set up a saline level monitoring system.

3 . PROPOSED WORK :

3.1 CIRCUIT DIAGRAM :

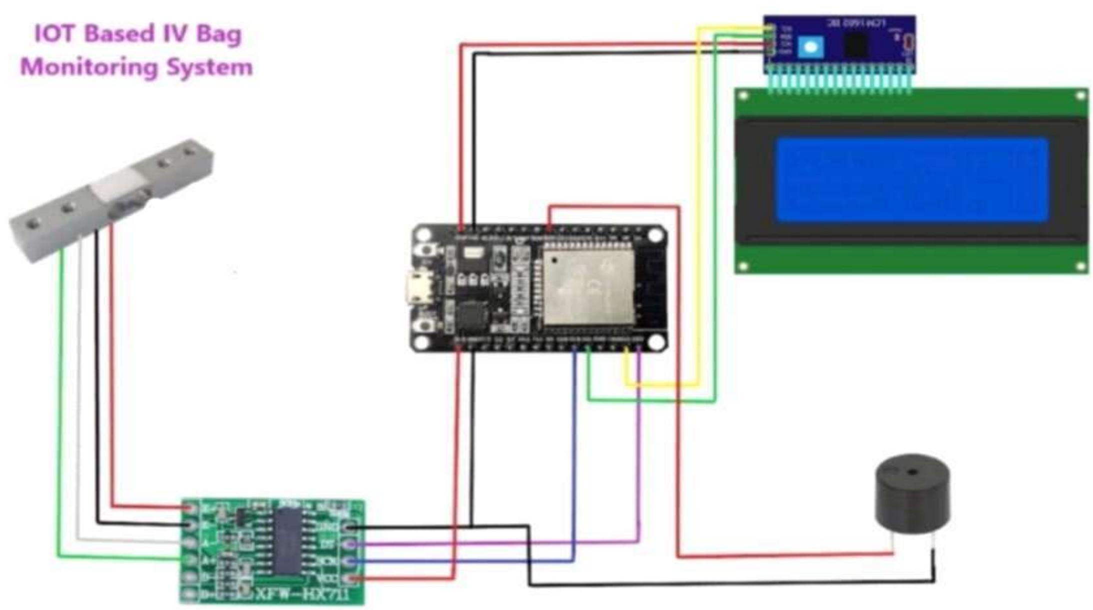

figure 3.1

3.2 COMPONENTS REQUIREMENTS :

1 ESP 32 WROOM MICROCONTROLLER :

figure 3.2.1

The ESP32 microcontroller in an IoT-based IV bag monitoring system collects data from sensors (e.g., weight, flow, and pressure), processes it, and uses Wi-Fi or Bluetooth to send alerts to medical staff or caregivers when the IV bag is low or anomalies occur. It enables real-time monitoring, remote access, and integration with IoT platforms for efficient and timely management of IV systems.

2. HX711 CONVERTER MODULE:

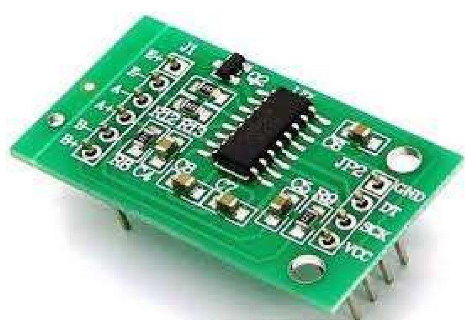

figure 3.2.2

HX711 Module: As shown in figure 3.1 a load cell or other strain gauge monitor is connected to a microcontroller or computer using the HX711 module, an electronic component. To precisely measure weight or force, it offers amplification, analog-todigital conversion, and digital signal processing function A load cell connector, an integrated circuit (IC), and a few inactive components make up the HX711 module in most cases. The IC has a 24-bit analog-to-digital converter, a lownoise amplifier, and a configurable gain amplifier. The load cell is connected to the HX711 module using the load cell connection. Using a serial interface, such as SPI or I2C, the HX711 module interacts with the microcontroller or computer. When precise weight or force measurement is necessary, the HX711 module is frequently used in automation applications, industrial process control systems, and electronic scales. It is a common option for both professionals and hobbyists due to its small size, low price, and high accuracy.

3.20X4 LCD DISPLAY WITH I2C :

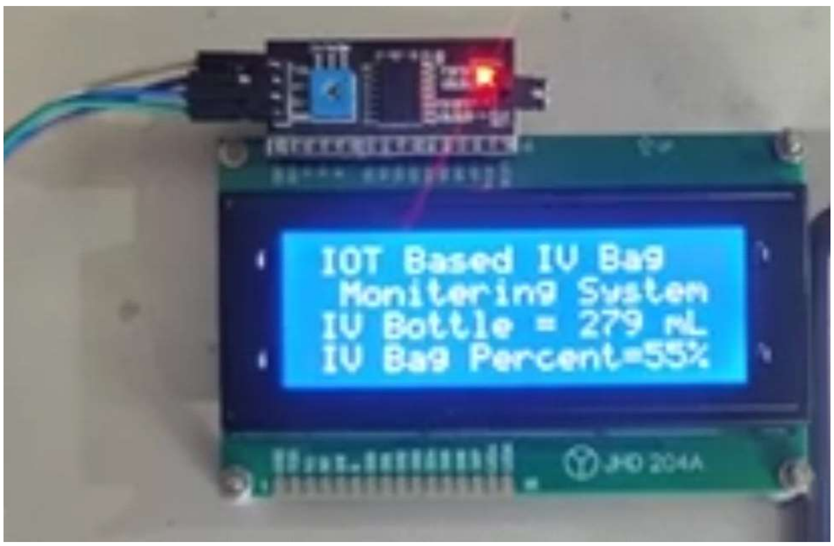

figure .3.2.3

Percentage Display:

As shown in the above figure 3.2.3 it displays the remaining fluid as a percentage of the total volume (e.g., IV Bag Percent= 55%").This is calculated based on the current weight or fluid volume and the total capacity of the IV bag.

Volume Display:

Shown in figure 3.2.3 LCD shows the actual volume remaining in the IV bag (e.g., "IV Bottle = 279 mL").The volume is determined using a HX711 load cell that measures the weight of the bag, and it is converted into fluid volume.

I2C Connector: A communication protocol that is frequently used in electronic devices for connecting different components, including LCD displays, is the I2C connector, commonly referred to as the I2C interface or I2C bus. InterIntegrated Circuit, or I2C, is a two-wire serial interface that enables several devices to interact with one another. With fewer pins needed and less complicated cabling, the I2C connector makes connecting an LCD display to a microcontroller or other devices easier. It permits numerous devices, each with an individual address, on the same bus facilitates bidirectional data flow. An easy and effective

4. LOAD CELL :

figure 3.2.4

A sort of transducer called a 10 kg load cell, also referred to as a weight Sensor, transforms the physical force of weight or pressure into an electrical signal. A metal housing, a strain gauge, and an analogueamplifier are usually included. A thin metal wire or foil known as the strain gauge is attached to a metal part, such as a beam or plate. The metal component of the load cell deforms when weight or pressure is applied, changing the strain gauge's resistance. The analogue amplifier then transforms this shift in resistance into an electrical signal. Numerous devices, including weighing scales, material testing equipment, and industrial process management systems, use load cells. Design, calibration, and environmental factors all affect a load cell's precision

5.BUZZER :

figure 3.2.5

A buzzer is used in an IV bag monitoring and alert system to generate an audible alert when an emergency or system malfunction occurs. The buzzer is activated when the fluid level in the IV bag reaches a predefined threshold. This helps to draw immediate attention to the situation and allows for prompt intervention

3.3 METHODLOGY :

The ESP32 is inbuilt with Wi-Fi module with the adapter, acts as the base of the circuit to perform all the IoT-based functions. It sends data over IoT to the Blynk app on the phone, therefore the medical staff can remotely monitor the delivery of IV fluid and is also responsible for sending alert notifications through the Blynk app as required. The changes taking place in the level of the IV fluid would be then displayed on the dashboard which has been developed with the help of Blynk. The prototype is programmed in a way such that, when the circuit is switched ON by the manual switch, it would establish a connection with the Wi-Fi network. Once the WiFi connection is established, the IV bag can be hung on the hook attached to the device. Then the circuit components get the weight of the IV bag/bottle and displays it on both the LCD display and the Blynk app. The 10kg load cell used is calibrated accurately before use so that it measures the weight accurately. The calibration factor is calculated by taking the ratio between the reading of weight shown on the LCD display and a known weight. This value is set in the Arduino code so that an accurate measurement of weight is obtained. The calibration factor may change according to the size of the load cell and its manufacturer. Since the density of saline is approximately equal to the density of water, the prototype uses water as the liquid in the IV bag, so the weight of water is approximately equal to the weight of saline. Therefore, the weight shown on the display/phone in grams is approximately equal to the volume of liquid remaining in the IV bag. As the fluid is delivered, so that the weight is gradually decreasing, alert notifications are sent to the nurse's phone through the Blynk app. When the weight becomes approximately equal to half of the full amount of IV fluid it will indicate that half of the IV is finished. Another notification alert is sent when the IV fluid level is low, therefore the nurse can replace or remove the IV bag as required .

5. RESULT:

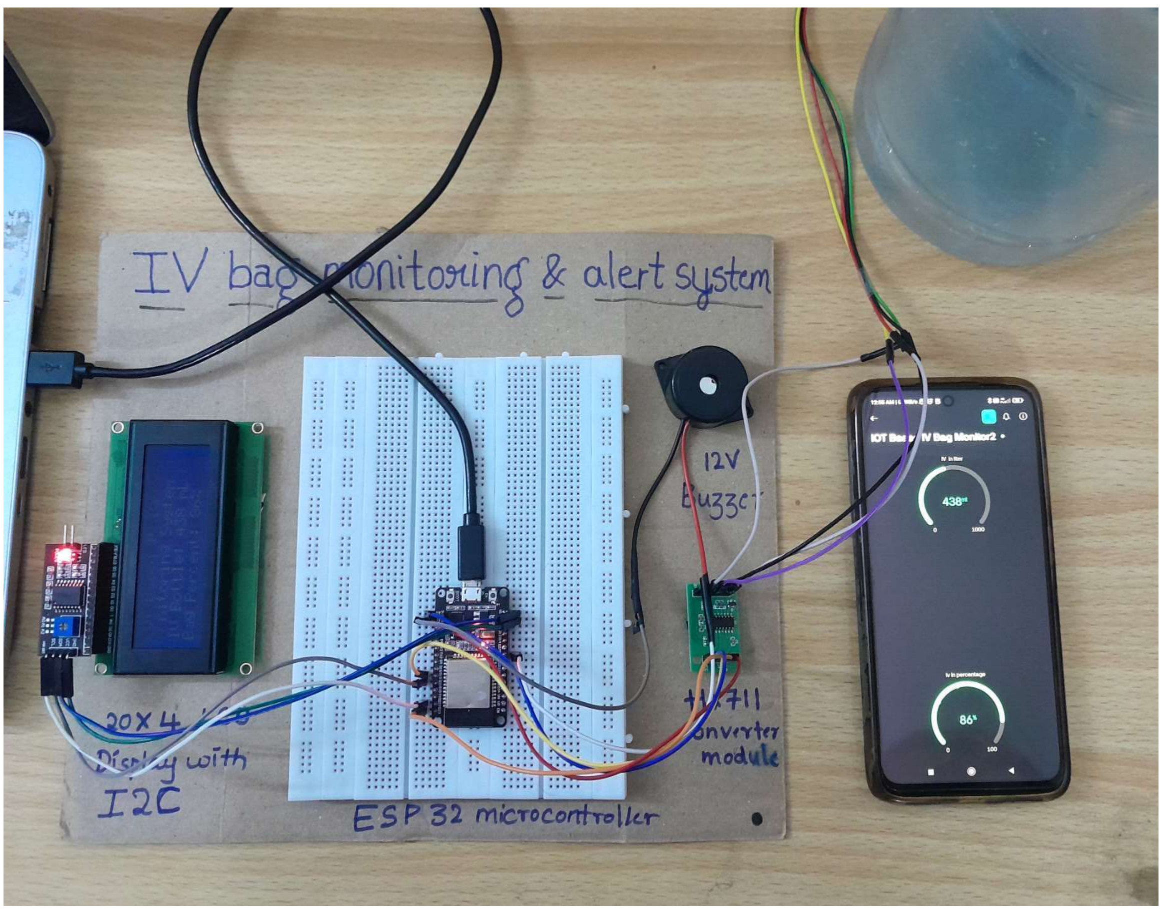

figure 5.1

The LCD should display the real-time weight or fluid level of the IV bag.

The smartphone app should show fluid levels in percentage and provide alerts if configured.The buzzer should activate when the fluid level falls below a certain threshold (e.g., 10%).

The smartphone app displays a fluid weight of 438g and a fluid percentage of 86%, indicating the IV bag is adequately filled.The LCD display is powered on, but the specific values are not visible in the image, likely showing similar data as the app.The buzzer remains inactive, signifying that the fluid level is above the predefined alert threshold.

The outcomes of implementing automated IV bag monitoring and alert systems in healthcare settings are largely positive, with significant improvements in patient safety, efficiency, and workflow management:

- Improved Patient Safety: Automated monitoring reduces the risk of IV bags running empty, minimizing the chance of air embolism and ensuring continuous medication and fluid delivery. This leads to fewer adverse incidents and enhanced patient safety.
- Increased Efficiency and Reduced Workload: By automating IV fluid level monitoring, nurses and healthcare staff are relieved from the need to check IV bags frequently. This allows them to spend more time on other critical tasks, increasing overall efficiency.
- Enhanced Workflow and Predictive Maintenance: These systems can predict when an IV bag will need to be replaced, enabling staff to plan and intervene proactively. This reduces the frequency of urgent or last-minute responses and helps streamline workflow.
- Cost Savings in the Long Term: Although initial costs may be high, automated systems can lead to cost savings by reducing incidents related to IV therapy errors and improving operational efficiency.

5.CONCLUSION:

In conclusion, an IoT-based monitoring and alert system provides real-time data collection, analysis, and automated alerts for efficient decision-making and proactive issue resolution. It enhances operational efficiency, safety, and resource management across various sectors. While offering scalability and remote access, it requires considerations for data security, privacy, and infrastructure costs.

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