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Smart Care's Iot Integration on Intravenous Monitoring

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Abstract— The task of keeping an eye on patients in a hospital throughout the day is difficult in the existing medical system. Physicians and nurses can have too much on their plates to care for every patient at once. This could endanger the lives of the sufferers. Due to the continuous influx of new patients during the COVID-19 epidemic, doctors and nurses are unable to keep an eye on every patient at all times. The task pertaining to health should be completed accurately and correctly. Injecting saline or intravenous (IV) fluid into a patient's vein is an example of this kind of labour in a hospital. Inadequate monitoring of the drip system can result in issues such as liquid backflow, blood loss, and other issues. We suggested the Smart Care's IoT Integration on Intravenous Monitoring System as a way to lessen strain and get out of such a tight spot when it comes to intravenous drip monitoring systems. The intravenous (IV) bag's weight is measured in this system using a load cell sensor. When the saline bag is empty, the system notifies the nurses or doctors so they can replace it or take it out when needed. Using the Blynk Software Platform, we may view the intravenous (IV) bag's liquid level on a mobile device in this system. A warning indicating that the task is incomplete will be sent again in five minutes if the IV bottle is not removed; if the bottle is changed, a notification will come as the task is completed.

I. INTRODUCTION

One of the emerging technologies in the current world is the Internet of Things (IoT). In our daily lives, it is more significant to increase job efficiency and save money by automating the modern human environment. The medical system in India is complex and multifaceted, incorporating both conventional and modern methods of treatment. Notwithstanding their extensive usage, the Indian healthcare system has a number of difficulties. One such difficulty is keeping an eye on intravenous bags. One prevalent and advanced technique used in hospitals and the medical industry is intravenous therapy.

A drip chamber, roller clamp, cannula, and bottle with a solution are the components of a basic IV set. The nurses, doctors, or carers should keep a close eye on the intravenous bag. The nursing team should regularly monitor the IV bag's liquid flow rate. Providers must accurately dose liquids based on the patient's condition in order to ensure the patient's safety and well-being. When an IV bag is empty or there is an irregular flow of fluids, one of the biggest problems with infusion is blood loss or backflow.

Reverse blood flow into the IV bag occurs if the empty bag is not replaced right away due to the pressure differential between the patient's blood pressure and the empty IV bag [6]. This illness would cause needless blood loss. This occasionally results in the patients' deaths. The suggested technique concentrates on keeping an eye on the amount of fluids within the IV bag in order to get around all of these issues. The primary goal of the suggested system is to offer an intravenous liquid level monitoring system that is dependable, easy to use, simple, and cost-effective.

II. RELATED WORKS

Author [1] The IV bag should be put on the load cell sensor if the system is turned on. The load cell sensor will calculate the weight and then communicate the information to the server. The liquid level of the IV bag will be detected by the moisture sensor, and the system will check the measured value. If the liquid level of the bag is lower than expected, an alarm message will be sent via the Telegram app, and a red alert will be sent via the IoT server.

Author [2] This technique eliminates the need for a nurse or doctor to continuously observe a patient from separate locations. It is understood that a patient's bodily state and IV fluid level must be constantly monitored.

Author [3] We have an Arduino coupled to a weight and flow sensor in this system. The initial weight of the IV bag will be determined by HX711. The liquid flow within the bottle will be recorded by the flow sensor. A buzzer will sound, the solenoid valve will stop the flow, and the application will update with the new status when the flow reaches a predetermined level.

Author [4] By subtracting the IV bag's capacity from the bottle's total discharge, the flow sensor will determine how much liquid is still in the bottle. It computes the liquid flow rate; the Raspberry is used to compute these data, which are then shown on an LCD and updated in Firebase.

Author [5] The load cell sensor in this system measures the liquid's capacity. The graphical chart at the nurse station shows the liquid level. The liquid level is continuously checked, and the nurse will change the IV bag whenever it reaches 25%. A bell will sound to alert the patient.

Author [6] The level sensor in this system is used to

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determine the liquid level and regulate the liquid's rate of drop. An alarm will be sent straight to the doctor if there is not enough liquid in the IV bag to empty it. Although the alerting system uses speech alerts, it does not use sounds.

Author [7] Here, the present system connects the drip chamber to the IV set. Every liquid drop is detected by a flow sensor. A beam of light will flash once a drop occurs. If the drop is not found for 45 seconds, the device will sound an alarm.

Author [8] This device employed an Arduino-based microcontroller to monitor the IV bag, manage the drip counter, and locate tube blockages. This system monitors the IV bag using optical sensors and low-power laser diodes. Users can remotely check the flow rate and infusion-interruption issues using mobile devices.

Author [9] This system is made up of a light sensor to find any bubble development in the IV bag and an ultrasonic sensor to check the liquid level in the bag. A control mechanism is in place to notify the nurses or doctors in the event that the liquid level in the IV bag dips below a predetermined level. This prevents air bubbles from forming and reverses blood flow.

Author [10] The suggested approach does away with the need for nurses or doctors to continuously observe patients on site. because IR sensors, Bluetooth, the CC2500 wireless module, and the ATMEGA 328 microcontroller are used. The ATMEGA 328 microcontroller is used in the system's development for programming. Infrared sensors measure the liquid level in the intravenous bag. The nurses will receive the notification using a transceiver that is a Bluetooth module and a wireless CC2500 module. The speaker will ring if the liquid level drops below the critical point.

III. METHODOLOGY

The components used in our project are: 1. Microcontroller ESP32; 2. HX711. 3.Load Cell Sensor; 4.20x4 LCD Display 5.12v Buzzer. 6.Blynk software. First, the ESP 32 is given a power supply and connected to a PC or laptop through a USB cable. The programming for the system is dumped into the microcontroller. Once turned on, the ESP 32 module is connected to the registered wireless network (Wi-Fi). Once the IV bag is placed in the load cell, the weight of the bag is calibrated, and the data is displayed on both the LCD display and the Blynk software. The HX711 module is connected to the microcontroller, which is used to convert the analogue into digital codes. If the weight of the IV bag is below the defined threshold value, normally below 20 ml, it sends an alert message to the defined user and triggers an alert through the buzzer. Here, the user can also set the threshold value based on the patient's health condition. The user can view the liquid level remotely through the Blynk software. It also triggers an alert when air bubbles form inside the tube. Here, the Blynk software acts as an interface between the microcontroller and the user. Live monitoring of the weight of the IV bag can be seen on both the LCD display and the Blynk software. It also informs the user when leakage occurs in the liquid flow by checking the flow rate of the liquid inside the IV bag. After the notification is sent, if intravenous bag is not removed after 5 minutes, an alert will be sent as the task is not completed, and if the IV bag is changed within 5 minutes, a notification will be sent as task completed.

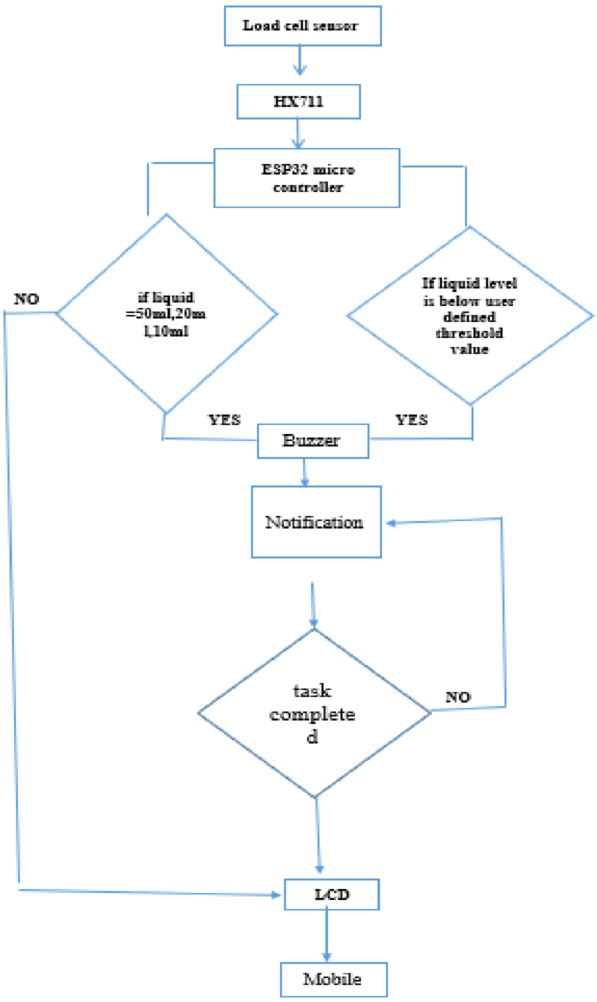

Fig. 3. Flow chart

IV. HARDWARE REQUIREMENTS

1) ESP 32 Microcontroller

Fig. 4.1. ESP 32 microcontroller

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The ESP32 microcontroller is used in IoT devices; it has built-in Wi-Fi and Bluetooth capacities, using which we can connect the devices to the internet. The ESP32 can be integrated with a wide range of sensors. The ESP32's has a combination of processing power, memory, and connectivity, which makes them well suited for all embedded systems applications.

2) Load Cell Sensor

Fig. 4.2. Load Cell Sensor

A transducer that transforms mechanical force into an electrical signal is called a load cell sensor. It is employed in situations where precise force, weight, or pressure measurements are required.

3) HX711

Fig. 4.3. HX711

HX711 is a precision 24-bit analog-to-digital converter (ADC) that is specially designed for weigh scales and industrial applications to interface directly with a bridge sensor. It operates at a current supply voltage of 2.7V to 5.5V, and it communicates with the microcontroller through a serial interface using I2C.

4) LCD

Fig. 4.4 LCD

Flat-panel display is used in electronic devices to see the output visually. These LCD's work by modulating the light through liquid crystals to produce the text on a screen. These LCDs consume very less power compared to the Cathode Ray Tubes (CRTs).

5) 12V Buzzer

Fig. 4.5.12V Buzzer

A buzzer is used to trigger a sound. In this system, we have used this buzzer to make an alarm sound to inform the nurse or doctor about the IV bag liquid level.

V. EXISTING SYSTEM

In the current medical system, the nurses or doctors in a hospital are manually monitoring the intravenous bag of a patient. There is an automatic process in which the weight sensor is used to monitor the intravenous bag. This system sends an alert message to the nurse or doctor through Telegram software. In this existing system, they have used a moisture sensor, which measures the liquid level in the bottle. If the liquid level reaches below the preset threshold value, it gives an alert message to the user.

VI. PROPOSED SYSTEM

In our proposed system we have used Load Cell Sensor to measure the weight of the IV bag with the liquid. The measurements will be sent to the HX711 which will convert the analog signals into digital signals. Then the converted value will be sent to the ESP32 Microcontroller which is connected with Wi-Fi, then we can see the level of liquid in mobile using Blynk Software. In this system, the alert message will be sent to the nurse or doctor. A buzzer will make sound if the Liquid in the Intravenous bag reaches 20ml and 10ml or user defined threshold value. The system includes an additional feature to send alerts to the user if the flow of liquid in the Intravenous Bag is halted or if there is presence of blood flow detected. If the IV bottle is not removed after 5 mins from the notification, an alert will be send again as task not completed and if the IV bottle is changed, a notification will sent as task completed.

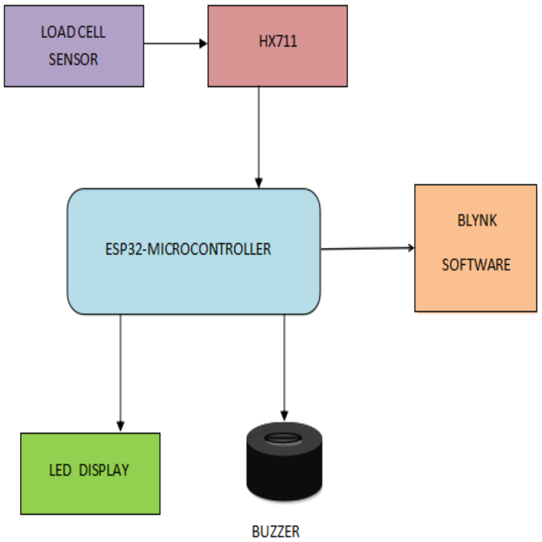

Fig. 6.1 Block Diagram

VII. OUTPUT AND RESULT

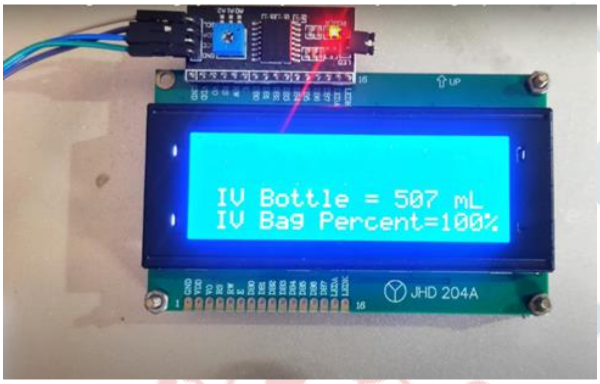

Fig. 7.1

In Fig 7.1 represents the output viewed in LCD which displays the amount of liquid in IV bottle in both milliliters (ml) and Percentage (%), which is sent to the LCD through the ESP32 microcontroller.

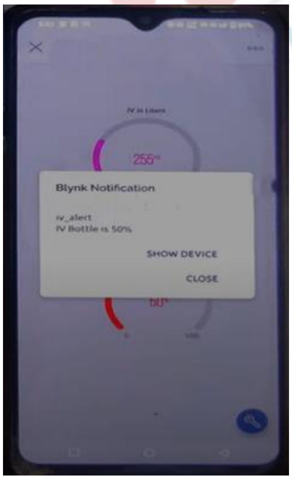

Fig. 7.2

In Fig 7.2 represents the notification that is sent to the nurse or doctor's mobile phone through the Blynk application. This notification will appear if the liquid lev89855el in the bottle goes 50% ,20% and 10% or if the flow of the liquid in the bottle is stopped or if any blood flow is detected in the flow of liquid.

Fig. 7.3

Fig 7.3 represents that the level of the liquid in the bottle can be viewed in the nurse or doctor's mobile phone in both Milliliters and percentage using the Blynk application.

VIII. CONCLUSION

The development and implementation of the SmartCare Automatic Intravenous Monitoring System signify the progress in the healthcare technology. This development holds the promising prospects for enhancing the both patient safety and operational efficiency. This project not only enhances the patient safety but also reduce the likelihood of errors, enhances the quality of care. In this project we have reduced the work pressure of the doctors and nurses by making their work easy. As there is notification and buzzer system, that works when the liquid in the IV bottle goes beyond the threshold value. This could save the backflow of liquid

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