VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Mini Project

Topic : IOT Based IV Bag Monitoring System in Blynk Using ESP32

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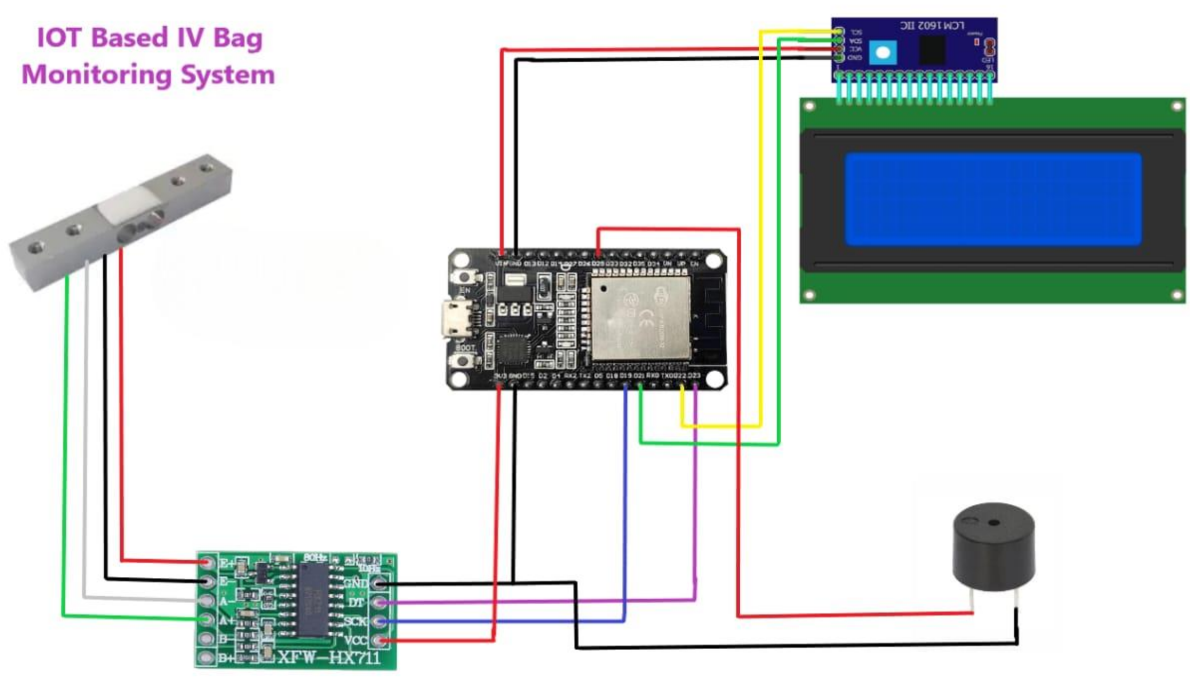
Abstract:

This project introduces an IoT-based IV bag monitoring system that leverages the capabilities of the ESP32 microcontroller and the Blynk platform. The system employs a load cell sensor to accurately measure the weight of the IV bag, which serves as a reliable indicator of the remaining fluid volume. This crucial data is then transmitted wirelessly to the Blynk server, enabling real-time visualization and analysis on a user-friendly mobile app.

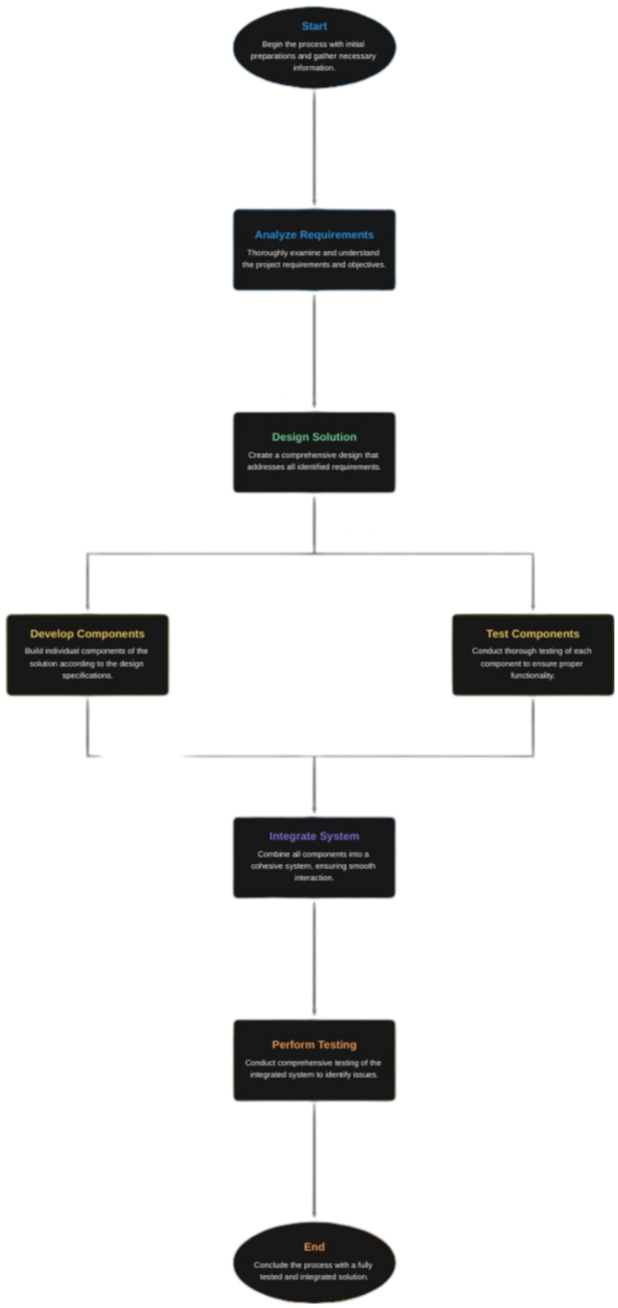
A key feature of this system is its ability to provide real-time monitoring of IV fluid levels, ensuring timely intervention by healthcare professionals. The remote accessibility offered by the Blynk app empowers healthcare providers to monitor patient status from anywhere, facilitating remote patient care. Additionally, the system is equipped with automated alert notifications that are triggered when fluid levels reach critical thresholds, preventing potential complications.

This innovative solution not only enhances patient safety but also reduces the workload of healthcare staff, ultimately improving overall efficiency in healthcare settings.

Block Diagram:



FLOWCHART



Start
Begin the process with initial preparations and gather necessary information.
Analyze Requirements
Thoroughly examine and understand the project requirements and objectives.
Design Solution
Create a comprehensive design that addresses all identified requirements.
Develop Components
Build individual components of the solution according to the design specifications.
Test Components
Conduct thorough testing of each component to ensure proper functionality.
Integrate System
Combine all components into a cohesive system, ensuring smooth interaction.
Perform Testing
Conduct comprehensive testing of the integrated system to identify issues.
End
Conclude the process with a fully tested and integrated solution.

Hardware Description:

ESP32 WROOM Microcontroller:

The ESP32-WROOM is a powerful and versatile Wi-Fi and Bluetooth module based on the ESP32 chip. It offers a wide range of features, including dual-core processors, Wi-Fi and Bluetooth connectivity, and a rich set of peripherals. This makes it ideal for various IoT applications, such as home automation, wearables, and industrial automation.

The ESP32-WROOM is easy to use and has a large community of developers, making it a great choice for both beginners and experienced developers. It is also cost-effective, making it accessible to a wide range of users. With its powerful features and affordability, the ESP32-WROOM is a popular choice for IoT projects of all sizes.

Load Cell Sensor:

A load cell is a transducer that converts mechanical force or weight into a measurable electrical signal. It consists of strain gauges, which are tiny electrical resistors that change resistance when subjected to strain. When a force is applied to the load cell, it deforms slightly, causing the strain gauges to change resistance. This change in resistance is measured and converted into an electrical signal, which is proportional to the applied force.

Load cells are widely used in various industries and applications, such as industrial weighing, laboratory equipment, medical devices, automotive, and aerospace. They are known for their high accuracy, reliability, and durability, making them essential components in many industrial and scientific applications.

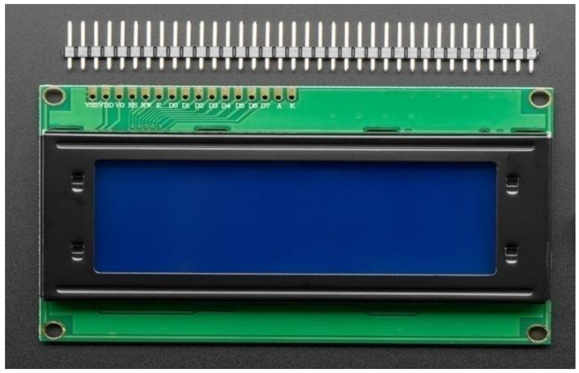
HX711 Converter Module:

The HX711 is a high-precision, 24-bit A/D converter module designed for weighing applications. It's commonly used with load cell sensors to accurately measure weight or force.

The HX711 amplifies the analog signal from the load cell and converts it into a precise digital value. This digital output can be easily read by a microcontroller, allowing for accurate weight measurements.

Key features of the HX711 include high precision, low power consumption, flexible configuration, and a simple interface. It's widely used in industrial weighing scales, laboratory balances, medical scales, and DIY projects.

20 X 4 LCD Display:

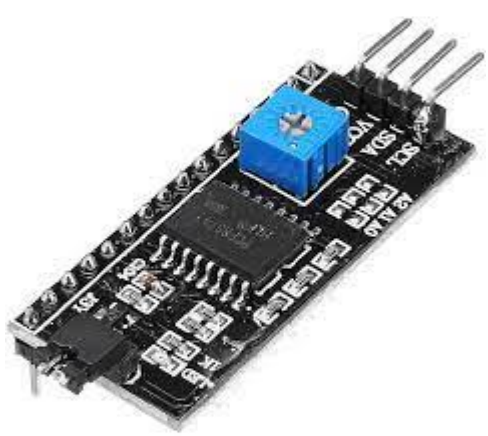


A 20x4 LCD display is a common type of character display that can display 20 characters on each of its 4 lines. It's widely used in various electronic projects due to its clarity, affordability, and ease of use.

To interface an LCD display with a microcontroller, you typically need to connect it to the microcontroller's data, control, and power pins. The microcontroller sends commands and data to the LCD, which are interpreted by the LCD's controller IC to display characters on the screen.

20x4 LCD displays are used in a wide range of applications, including embedded systems, IoT devices, hobbyist projects, and industrial applications. They provide a clear and informative way to display text and data on electronic devices.

I2C-Inter Integrated Circiut:



I2C, or Inter-Integrated Circuit, is a serial communication protocol that uses two wires to connect multiple devices. It's widely used in electronic systems for short-distance communication.I2C uses a master-slave architecture, where one device (master) controls the communication and others (slaves) respond. Data is transmitted bit by bit, synchronized by a clock signal. Each device on the bus has a unique address, allowing the master to select specific devices.I2C is simple to implement, flexible, low-cost, and power-efficient. It's commonly used for interfacing sensors, displays, memory devices, and motor controllers.

12V Buzzer:

A 12V buzzer is an electronic sounder that produces a beeping or buzzing sound when activated by a 12V DC power supply. It's a common component used in various electronic projects and devices to provide audible alerts or notifications.

There are two main types of 12V buzzers: piezoelectric and electromagnetic.

- Piezoelectric buzzers are smaller, energy-efficient, and produce a higher-pitched sound.
- Electromagnetic buzzers are larger, louder, and produce a lower-pitched sound.

12V buzzers are used in a wide range of applications, including alarms, timers, electronic toys, automotive systems, and industrial equipment. To use a 12V buzzer, simply connect it to a 12V power supply and control its on/off state using a switch or microcontroller.

Software Description:

The IoT-based IV Bag Monitoring System leverages the Blynk platform and ESP32 microcontroller to provide real-time remote monitoring of IV fluid levels. The software component comprises the following key elements:

Blynk App:

- User Interface: A user-friendly interface is designed to display real-time IV fluid levels, historical data, and alert notifications.
- Remote Control: Users can remotely monitor and control the system, including setting alerts and viewing historical data.
- Data Visualization: The app visualizes data in a clear and intuitive manner, such as charts and graphs.

ESP32 Firmware:

- Sensor Data Acquisition: The firmware continuously reads data from the load cell sensor, which measures the weight of the IV bag.
- Data Processing: The raw sensor data is processed to calculate the remaining fluid volume.
- Wireless Communication: The processed data is transmitted wirelessly to the Blynk cloud server using the ESP32's Wi-Fi capabilities.
- Alert Triggers: The firmware monitors fluid levels and triggers alerts when they reach critical thresholds.
- Data Logging: Historical data on fluid consumption is stored and can be accessed through the Blynk app.

ARDUINO IDE CODE:

```
#include <WiFi.h>

#include <WiFiClient.h>

#include <BlynkSimpleEsp32.h>

#include <LiquidCrystal_I2C.h>

#include <HX711.h>

LiquidCrystal_I2C lcd(0x27, 20, 4); // Adjust this to your LCD I2C address

#define DOUT  23
```

```
#define CLK  19
#define BUZZER 25
HX711 scale; // Corrected declaration of scale
#define BLYNK_PRINT Serial
#define BLYNK_TEMPLATE_ID "TMPL3IkzbPwhV"
#define BLYNK_TEMPLATE_NAME "IOT IV bag monitor"
#define BLYNK_FIRMWARE_VERSION  "0.1.1"



char auth[] = "Ko_vRjpVTJr5CBWkFdE0nD_LAYi4DHxW";// Bylnk
char ssid[] = "Hahahahaha";//Name of the network
char pass[] = "yuzichahal03";// password
int liter;
int val;
float weight;
float calibration_factor = 102500; // change this value for your Load cell sensor
void setup() {
  Serial.begin(115200);
  lcd.init();
  lcd.backlight();
  pinMode(BUZZER, OUTPUT);
  Serial.println("Remove all weight from scale");
  scale.begin(DOUT, CLK); // Initialize the scale
```

```
  scale.set_scale(); // Set the scale to default
   scale.tare(); // Reset the scale to 0
  long zero_factor = scale.read_average(); // Get a baseline reading
  Serial.print("Zero factor: ");
  Serial.println(zero_factor);
  Blynk.begin(auth, ssid, pass);
}

void loop() {
  Blynk.run();
  measureweight();
}
void measureweight() {
  scale.set_scale(calibration_factor); // Adjust to this calibration factor
  weight = scale.get_units(5);
if(weight < 0) {
    weight = 0.00;
  }
  liter = weight * 1000;
  val = liter;
  val = map(val, 0, 505, 0, 100);
  lcd.clear();
  lcd.setCursor(1, 0);
```

```
lcd.print("IOT Based IV Bag");

lcd.setCursor(2, 1);

lcd.print("Monitoring System");

Serial.print("Kilogram: ");

Serial.print(weight);

Serial.println(" Kg");

lcd.setCursor(1, 2);

lcd.print("IV Bottle = ");

lcd.print(liter);

lcd.print(" mL");

Serial.print("IV BOTTLE: ");

Serial.print(liter);

Serial.println(" mL");

lcd.setCursor(1, 3);

lcd.print("IV Bag Percent=");

lcd.print(val);

lcd.print("%");

Serial.print("IV Bag Percent: ");

Serial.print(val);

Serial.println("%");

Serial.println();

delay(500);

if (val <= 50 && val >= 40) {
```

```
    Blynk.logEvent("iv_alert", "IV Bottle is 50%");
    digitalWrite(BUZZER, HIGH);
    delay(50);
    digitalWrite(BUZZER, LOW);
    delay(50);
  } else if (val <= 20) {
    Blynk.logEvent("iv_alert", "IV Bottle is too LOW");
    digitalWrite(BUZZER, HIGH);
  } else {
    digitalWrite(BUZZER, LOW);
  }
Blynk.virtualWrite(V0, liter);
 Blynk.virtualWrite(V1, val);
}
```

WORKING:

Weight Sensing and Signal Conditioning**:**

- Load Cell Sensor: This sensor is attached to the IV stand and measures the weight of the IV bag.
- Analog Signal: The weight change is converted into an analog electrical signal by the load cell.
- Signal Amplification: The weak analog signal is amplified using an amplifier like the HX711 to ensure accurate measurement, especially for small weight variations.
- Analog-to-Digital Conversion (ADC): The amplified analog signal is converted into a digital signal that can be processed by the microcontroller.

Microcontroller Processing:

- Data Acquisition: The microcontroller continuously reads the digital signal from the ADC.
- Initial Weight Measurement: The initial weight of the full IV bag is recorded as a reference point.
- Real-time Weight Monitoring: The microcontroller continuously monitors the current weight of the bag.
- Fluid Volume Calculation: By comparing the current weight to the initial weight, the microcontroller calculates the remaining fluid volume.
- Flow Rate Calculation: The microcontroller can also calculate the flow rate of the IV fluid by monitoring the weight change over time.
- Anomaly Detection: The system can be programmed to detect anomalies like sudden drops in fluid level or irregular flow rates, indicating potential issues.

Wireless Communication:

- Wi-Fi Connectivity: The ESP32 microcontroller uses its built-in Wi-Fi module to connect to the internet.
- Data Transmission: The calculated fluid volume, flow rate, and any detected anomalies are transmitted to the Blynk cloud platform.

Cloud-Based Monitoring and Alerting:

- Data Visualization: The Blynk platform receives the transmitted data and displays it on a user-friendly dashboard, providing real-time insights into the IV bag status.
- Alert Generation: If the fluid level falls below a predefined threshold, the flow rate is abnormal, or other issues are detected, the platform can trigger alerts via email, SMS, or push notifications to healthcare professionals.
- Remote Monitoring: Healthcare providers can access the Blynk dashboard remotely to monitor multiple patients' IV bags simultaneously.

Sensor Data Acquisition:

- The ESP32 microcontroller continuously reads the weight data from the load cell sensor, which is attached to the IV bag.
- The load cell sensor converts the weight of the IV bag into an analog voltage signal.
- The HX711 amplifier module amplifies this signal and converts it into a digital value.

Data Processing:

- The ESP32 processes the digital weight data to calculate the remaining fluid volume in the IV bag.
- The calculated fluid volume is converted into a percentage value to indicate the remaining fluid level.

Wireless Communication:

- The ESP32, equipped with Wi-Fi capabilities, transmits the processed data (fluid level and percentage) to the Blynk cloud server.
- This data transmission occurs wirelessly over the internet.

Data Storage and Visualization:

- The Blynk cloud server stores the received data for future reference and analysis.
- The data is displayed on the Blynk app in real-time, providing a visual representation of the IV fluid level and percentage.

Alert Notifications:

- The system monitors the fluid level and triggers alerts when it reaches critical thresholds.
- These alerts can be configured to notify healthcare professionals via the Blynk app or other communication channels.

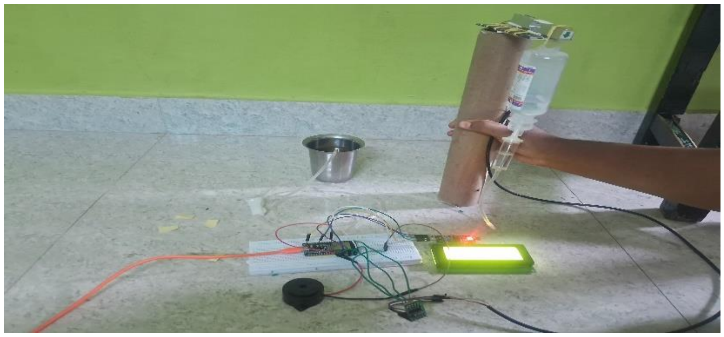
User Interaction:

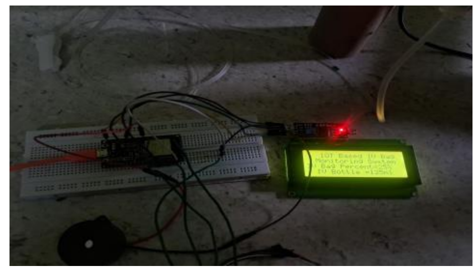
- Healthcare professionals can access the Blynk app to monitor the IV fluid level remotely.
- They can view historical data, set alerts, and receive notifications.

Additional Considerations:

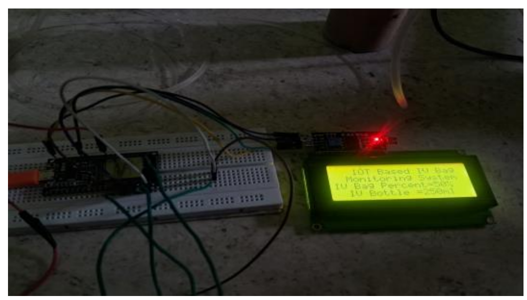
- Security: Secure communication protocols should be used to protect sensitive patient data during transmission.
- Calibration: Regular calibration of the load cell sensor is essential to ensure accurate measurements.
- Environmental Factors: The system should be designed to be robust against environmental factors like temperature and humidity, which can affect sensor performance.

WORKING MODEL:



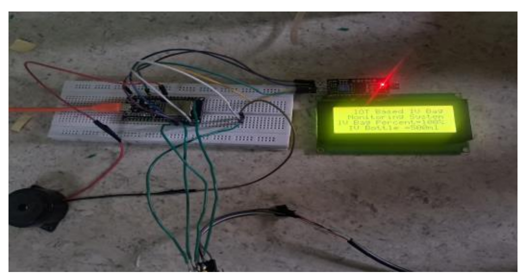


IV BOTTLE- 250ml



OUTPUT: IV Bag Percent – 50%

IV BOTTLE- 1000ml



OUTPUT: IV Bag Percent – 100%

APPLICATIONS

Enhanced Patient Care:

- Real-time Monitoring: Continuous tracking of fluid levels, flow rates, and infusion times allows for immediate detection of anomalies, ensuring timely intervention.
- Reduced Medication Errors: Minimizes the risk of over- or under-infusion, leading to improved patient safety and medication adherence.
- Early Detection of Complications: Detects potential complications like air embolism, infiltration, and extravasation early on, enabling prompt corrective actions.
- Personalized Treatment: Tailored treatment plans based on real-time data and patient-specific needs.

Improved Operational Efficiency:

- Automated Alerts and Notifications: Timely alerts for low fluid levels, high flow rates, or equipment malfunctions, reducing the workload of healthcare staff.
- Remote Monitoring: Enables remote monitoring of patients, especially in telemedicine and home healthcare settings, optimizing resource allocation and reducing the need for frequent physical check-ups.
- Data-Driven Insights: Collects valuable data on fluid administration, patient response, and medication effectiveness, facilitating data-driven decision-making and continuous improvement.
- Streamlined Workflow: Automates routine tasks, reducing the burden on healthcare staff and improving overall efficiency

Specific Use Cases:

- Pediatric Units: Precise monitoring of fluid administration in infants and children, ensuring accurate dosage and preventing dehydration or fluid overload.
- Intensive Care Units (ICUs): Continuous monitoring of critically ill patients receiving multiple IV infusions, optimizing fluid balance and reducing the risk of complications.

- Surgical Units: Real-time tracking of fluid balance during and after surgery, minimizing the risk of hypovolemia or fluid overload.
- Home Healthcare: Remote monitoring of patients receiving IV therapy at home, providing peace of mind for both patients and caregivers.
- Geriatric Care: Ensuring accurate and timely medication delivery to elderly patients, reducing the risk of adverse drug reactions and improving quality of life.

CONCLUSION

IoT-based IV bag monitoring systems represent a significant advancement in healthcare technology, offering numerous benefits for both patients and healthcare providers. By leveraging the power of IoT, these systems enable real-time monitoring, automated alerts, and remote access, leading to improved patient safety, enhanced operational efficiency, and better clinical outcomes.

As technology continues to evolve, we can expect further innovations in this field, such as advanced analytics, predictive modelling, and integration with other medical devices. By embracing IoT-powered solutions, healthcare providers can deliver more effective and personalized care, ultimately improving patient satisfaction and outcomes.