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IoT Based IV Broad Spectrum Antibiotics Injection Supply

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Abstract: This project focuses on developing an IoT-based healthcare monitoring system designed to continuously monitor a patient's body temperature and ensure timely medical intervention during critical situations. The system uses temperature sensors to track the patient's body condition in real time and sends instant notifications to doctors through a mobile or web-based IoT application whenever abnormal temperature levels are detected. This allows physicians to take quick and appropriate medical decisions without delay. A key feature of the system is the automatic control of intravenous (IV) fluid or broad-spectrum antibiotic supply when the patient's temperature exceeds a predefined threshold level. This automation reduces dependency on manual monitoring by healthcare staff and ensures that the patient receives immediate treatment during emergencies. The system also enables remote patient monitoring, accurate data recording, and efficient communication between sensors, medical devices, and healthcare providers. By integrating IoT technology into healthcare systems, the proposed solution aims to improve patient safety, reduce emergency response time, and enhance the overall efficiency and reliability of hospital monitoring systems.
Keywords: Internet of Things, IV Drug Delivery, Temperature Sensing, Arduino-Based Control

I.INTRODUCTION

An IoT-based IV broad spectrum antibiotics injection supply system is a smart healthcare solution designed to automate and monitor the administration of intravenous antibiotics to patients using Internet of Things (IoT) technology. This system aims to ensure accurate dosage, timely delivery, and continuous monitoring of antibiotic infusion, particularly for elderly patients and those requiring critical care. By integrating sensors, microcontrollers, and wireless communication, the system can monitor patient health parameters such as temperature, heart rate, and fluid levels, and transmit real-time data to healthcare professionals through a cloud-based platform. It also helps reduce human errors, improves treatment efficiency, and enables remote supervision by doctors. The increasing demand for advanced healthcare monitoring and the need for effective infection control have led to the development of such automated systems, which enhance patient safety, optimize drug administration, and support efficient hospital management through intelligent and connected medical devices.

II. LITERATURE SURVEY

[1] IoT Based Intravenous Fluid Monitoring & SMS Alerting [11] - Author Name: Pushpa Thamboor; Bhupathi Gowthami; Budidha Trisha; Chinthala Lokesh. By Providing Sensors in the IV Fluid Monitoring System, Healthcare Workers & Hospitals are Able to Monitor & Track IV Fluids with Advanced Sensor Technologies, as well as Receive Alerts via SMS Text or HTML for The Levels of the IV Fluids. The IV Fluid Monitoring System Includes Several Safety Features, including Air Bubble Detection and Ambient Temperature Readings for the IV Fluids, and Provides Multi-Modal Alerts (Visual, Auditory, & Vibratory) to Increase Patient Safety, Enhance IV Safety, and Provide an Economically & Environmentally-Friendly IV Fluid Monitoring System. Another Feature of This IV Fluid Monitoring Device is The Ability to Monitor Compatibility for All Medications Administered through the IV Tube, Allowing for A Lower Risk of Adverse Drug Interactions That May Negatively Impact Patients. This IV Fluid Monitoring Device Constantly Monitors The IV Fluid Level In Real Time with Limited to No Healthcare Worker Intervention Via IoT Technologies.

The Monitoring Device Includes Both Manual Monitoring & Automated Monitoring, Providing A Higher Standard of Patient Care In Hospitals, Clinics, & Homes. [2] Intelligent Intravenous Fluid Monitoring System For Health Surveillance Applications- Author Name: Venkat S; Annalakshmi T; Vanitha L; Arun Karthik M; Hari Prakash N; Jerin Abhishek K[12] The main purpose of an IV Bag Monitoring System is to provide real-time monitoring and control of intravenous fluid administration. This technology helps healthcare providers maintain accurate dosage, decrease the hazard of difficulties, and improve the overall quality of care for patients receiving IV therapy. Specialized sensors are connected to the IV bag and tubing to measure various parameters, including fluid flow rate, volume remaining in the bag, and the pressure within the system. A central control unit or computerized interface receives data from the sensors, interprets it, and displays relevant information to healthcare professionals. The system is equipped with alarms and alerts that notify healthcare staff of any irregularities, such as low fluid levels, incorrect dosages, or potential obstructions in the IV line. The system provides continuous, real-time updates on the status of the IV fluid administration, including flow rate and volume administered. By monitoring the flow rate and volume, the system helps ensure that patients receive the correct dosage of medications or fluids.

[3] Smart IV Bag Monitoring and Alert System- Author Name: Amulya A Shetty; Pushpa G; Adithya Balasubramanyam[9] In recent years, technological innovations have considerably improved patient care and accelerated the healing process. Effective hydration and electrolyte management are two of the most important parts of hospital care. Intravenous(IV) treatment is critical, especially for patients in intensive care units (ICUs). However, the difficulties of overloaded hospitals frequently impede the seamless administration of this critical care. Currently, manual monitoring of IV drip levels is the responsibility of nurses and hospital employees. Unfortunately, their hectic schedules might lead to mistakes and omissions. Acknowledging the significance of tackling this core problem, the suggestion involves the creation of an independent, self-regulating drip monitoring system utilizing Internet of Things (IoT) technology. This entails the incorporation of ultrasonic and LDR sensors with the ESP8266, all programmed using Arduino UNO language. This novel technology intends to revolutionize drip monitoring by overcoming obstacles such as bubble formation in IV drips and removing the need for sophisticated alarm systems.

[4] Intelligent Intravenous Drip Stand for Safe Infusions Using IoT Integration- Author Name: Sushma Philipraj; Remya Raj[13]. Drip infusion monitoring is a tedious job for nurses or caretakers. At night time, there are chances that the bystanders forget to inform the nurse about the depleted bottle causing inconvenience to the patient. Human negligence can cause back flow of blood, air embolism and many other major/minor problems if bottle is not replenished at right time. There is a need to continuously monitor the bottle. Our project focuses on monitoring and controlling system that provides a solution to the above mentioned problem. The level of bottle is continuously transmitted to nurse's phone improving his/her evaluable presence of all patients. The percentages 100, 80, 50, 20, 10 etc. were found correct in terms of the level observed. The latest technology Internet of Things (IoT) is used to build a bridge between nurse and patient. Non-contact level sensor are used to measure the level and send the data to the nurse station. After initiating the drip infusion, the drop in level can be viewed in nurse's phone.

[5] IV Drip and Flow Level Monitoring System- Author Name: C. Sivamani; Gokulraj P; Balavishnu M; Kesavan S[14]. This project is basically about making IV drip monitoring way smarter and less stressful using IoT tech. This project consist of load cell sensor with an HX711 amplifier that keeps track of the IV bag's weight to see how much fluid is left, and an infrared (IR) sensor that watches the drip to catch any blockages or if the flow stops. To collect all the received data from the sensor ESP32 microcontroller is used, which triggers the LED light and the buzzers when abnormal changes happen and also sends immediate alerts to a mobile app through the Blynk platform. Through this way, nurses always know when to change the IV bag, avoiding issues like backflow or air getting into the vein and makes the work less for the nurses. It's low-cost, accurate, super easy to set up, and really helps make patient care safer while making hospital work a lot smoother.

III. PROPOSED SYSTEM

The proposed model presents a smart and assistive home automation system designed to help physically disabled individuals operate household appliances through voice and Bluetooth communication. The system is developed using an Arduino Uno microcontroller, an HC-05 Bluetooth module, a 4-channel relay board, and electrical loads such as bulbs or fans. The main purpose of this design is to create a low-cost, simple, and reliable solution that improves user independence. Unlike traditional manual switches, this system enables wireless control through a smart phone, eliminating the need for physical movement several studies have focused on improving intravenous (IV) fluid monitoring using Internet of Things (IoT) technology. Pushpa Thamboor and team developed an IoT-based IV fluid monitoring system that uses sensors to track fluid levels and send alerts to healthcare staff through SMS or web notifications, improving patient safety.Venkat S and colleagues proposed an intelligent IV bag monitoring system that continuously measures flow rate, fluid volume, and pressure, ensuring accurate dosage and providing alarms when abnormalities occur. Amulya A.Shetty and co-researchers designed a smart IV monitoring system using ultrasonic and LDR sensors with an ESP8266 controller to automate drip monitoring and reduce manual supervision. Similarly, Sushma Philipraj introduced an IoT-based drip stand that continuously monitors the IV bottle level and sends real-time updates to nurses through mobile devices. Another system developed by C.Sivamani uses load cell and IR sensors with an ESP32 microcontroller to monitor IV fluid levels and detect flow issues, sending alerts through a mobile application. These studies highlight how IoT-based monitoring systems can improve accuracy, reduce human errors, and enhance patient safety in IV therapy management.

A. Working Principle: - Transmitter Section

The transmitter section of the IoT Based IV Broad Spectrum Antibiotics Injection Supply system is responsible for collecting and sending patient health data to the control system and IoT platform.

In this project, the transmitter mainly consists of the temperature sensor, Arduino Uno microcontroller, and NodeMCU Wi-Fi module. Initially, the temperature sensor continuously monitors the patient's body temperature and converts it into electrical signals.

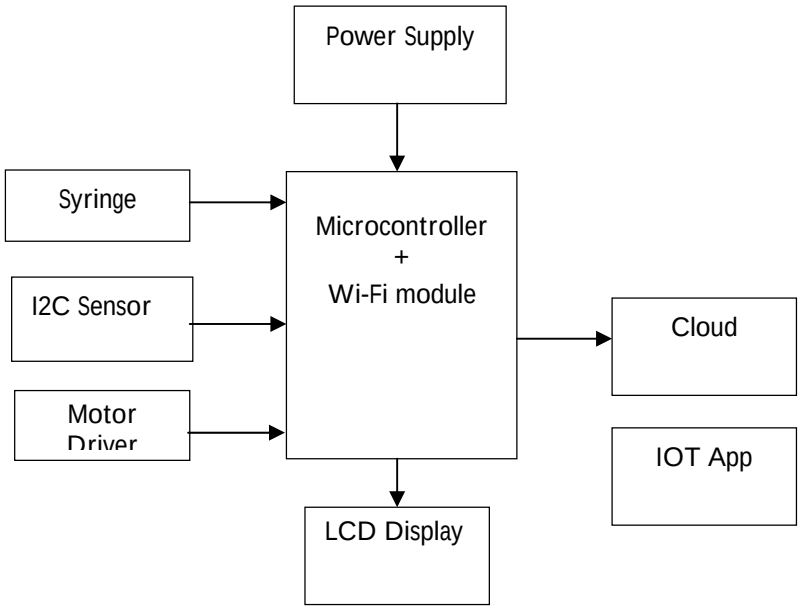

Figure 3.1. Block Diagram of Proposed System.

These signals are sent to the Arduino Uno, which processes the sensor data. The Arduino compares the measured temperature with the predefined threshold value stored in the program. The processed information is then transmitted to the NodeMCU Wi-Fi module, which connects the system to the internet. Using wireless communication, the NodeMCU sends the patient's temperature data and system status to the IoT platform or monitoring application. This enables doctors or healthcare staff to remotely observe the patient's condition in real time and receive alerts when abnormal temperature levels are detected.

Receiver Section

The receiver section of the system is responsible for performing the required action based on the commands generated by the microcontroller. This section mainly includes the motor driver (L298N), RPM DC motor, syringe mechanism, LCD display, and power supply unit. When the Arduino detects

B. Key Features - Wireless IoT Communication

The system uses IoT technology to transmit patient health data from sensors to a mobile or web application. This wireless communication allows doctors and caregivers to monitor the patient's condition remotely without being physically present near the patient.

Real-Time Health Monitoring

The system continuously monitors important health parameters such as body temperature, heart rate, and IV fluid level using sensors. This real-time monitoring helps in the early detection of abnormal health conditions and allows timely medical intervention.

Automatic Antibiotic Injection Control

One of the main features of the proposed system is the automatic control of IV broad spectrum antibiotic supply. When the patient's health parameters cross a predefined threshold level, the system automatically activates the IV injection mechanism to deliver the required medication.

User-Friendly Interface

The mobile application used in the system provides a simple and easy-to-understand interface. Doctors and caregivers can easily view patient health data, receive alerts, and monitor treatment status through the application.

Safety and Dosage Control

The system includes important safety mechanisms such as IV fluid level detection, controlled dosage administration, and emergency alert notifications. These features help prevent over-administration of antibiotics and ensure safe treatment.

Remote Monitoring and Alerts

Through IoT connectivity, the system sends real-time alerts and notifications to doctors or caregivers when abnormal conditions are detected. This helps in reducing response time during medical emergencies and improves patient care that the patient's temperature exceeds the predefined threshold level, it sends a control signal to the motor driver module. The motor driver amplifies the signal and controls the RPM DC motor, which is mechanically connected to the syringe mechanism. Once activated, the motor rotates at a controlled speed and pushes the syringe plunger, allowing the antibiotics to be injected into the IV line in a precise and controlled manner. This automated process ensures that the patient receives medication immediately when required. At the same time, the LCD display (16×2) shows important information such as temperature readings, injection status, and alert messages. The LCD communicates with the Arduino through the I2C module, which simplifies wiring and improves communication efficiency.

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C. Advantages over Proposed System:

The proposed IoT-based IV broad spectrum antibiotics injection supply system offers several advantages in modern healthcare monitoring and treatment. One of the major benefits is the automation of antibiotic delivery based on the patient's real-time health condition, which reduces the need for constant manual monitoring by medical staff. The system continuously monitors important patient parameters such as body temperature, heart rate, and IV fluid level using sensors, allowing early detection of abnormal conditions. With the help of IoT connectivity, patient data and alerts can be sent instantly to doctors or caregivers through a mobile or web application, enabling remote monitoring and faster medical response. The system also improves patient safety by including features such as controlled dosage, IV fluid level detection, and Emergency alerts to prevent over-administration of drugs. Additionally, the automated process ensures accurate drug delivery and reduces human errors. By minimizing manual intervention and enabling continuous monitoring, the system reduces the workload of healthcare professionals while improving treatment efficiency and overall patient care.

D. Hardware Components:

- ESP8266, Arduino UNO Cable, Syringe, Motor Driver, RPM Motor, I2C Sensor, Power Supply

VI.SOFTWARE REQUIREMENTS

A. Arduino IDE

Arduino IDE (Integrated Development
Environment) is open-source software used to write, compile, and upload programs to Arduino and other compatible microcontrollers.

Features:

Arduino IDE provides a simple and user-friendly interface for programming. It supports multiple libraries, allows code editing and compilation, and includes a serial monitor to view real-time data from sensors and devices.

Purpose:

In this project, Arduino IDE is used to develop and upload the program that controls sensors, processes patient health data, and manages the IV antibiotic injection system.

B. Embedded C Language

Embedded C is a programming language based on the C language that is specifically used for programming embedded systems and microcontrollers.

Features:

It allows direct interaction with hardware components such as sensors, actuators, and communication modules. Embedded C is efficient, fast, and suitable for real-time system operations.

Purpose:

In this project, Embedded C is used to write the program that reads sensor data, analyzes the patient's health condition.

C. Mobile Application

Blink

V.HARDWARE REQUIREMENTS

A. Arduino Uno

Arduino Uno is a microcontroller board used as the main controlling unit of the system. It processes input signals from sensors and controls other hardware components such as the motor driver.

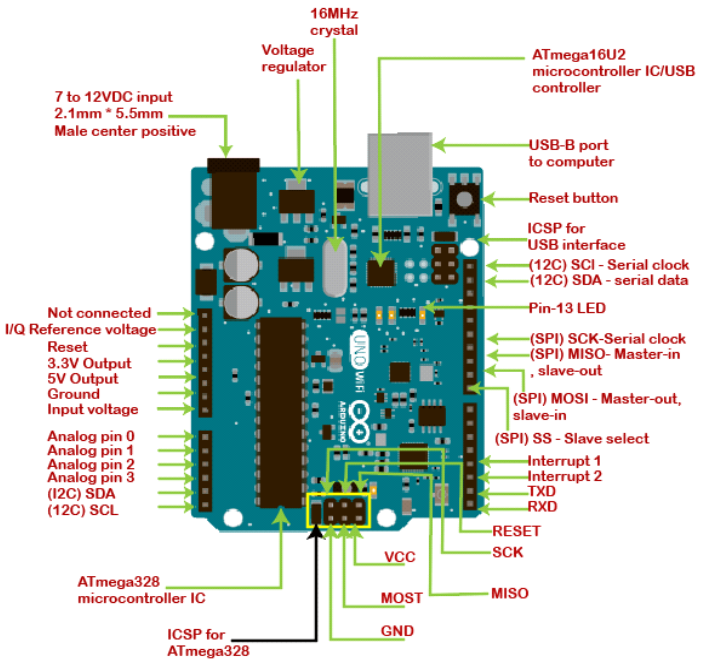

Figure 5.1 Arduino Uno

Features:

Based on ATmega328P microcontroller. Provides 14 digital input/output pins and 6 analog input pins. Operates at 5V with 16 MHz clock speed. Supports USB programming using Arduino IDE. Acts as the central processing unit of the system.

B. NodeMCU (ESP8266 Wi-Fi Module). NodeMCU is a Wi-Fi enabled microcontroller module used to connect the system to the internet and transmit data to IoT platforms or remote devices.

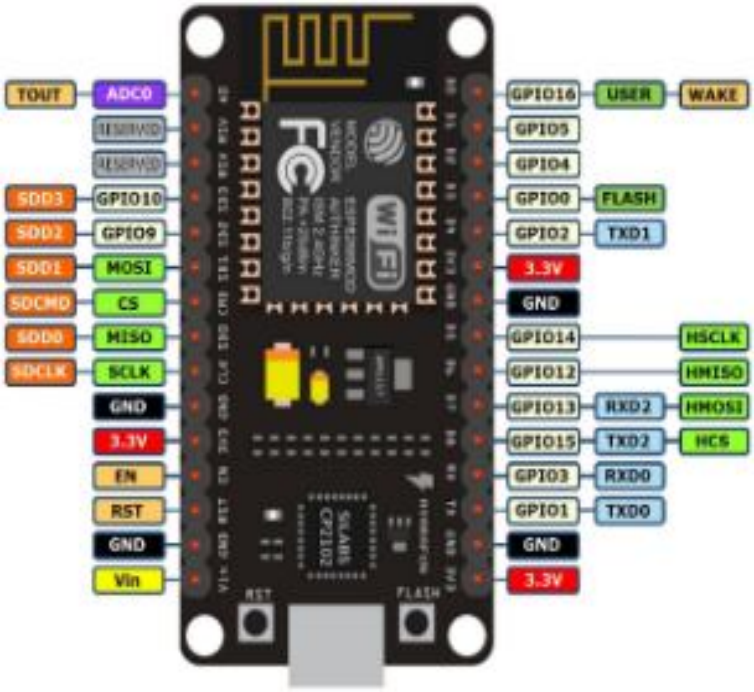

Figure 5.2 Node MCU

Features:

Built-in Wi-Fi connectivity., Supports TCP/IP networking protocols. Enables remote monitoring through cloud platforms. Low power consumption and high processing capability.

C. Temperature Sensor

Definition: The temperature sensor is used to measure the patient's body temperature continuously and send the data to the microcontroller for analysis.

Features: Detects body temperature changes accurately. Converts temperature into electrical signals.

D. Motor Driver (L298N)

Definition: The motor driver is an electronic module that controls the speed and direction of the DC motor used in the syringe injection mechanism. Features: Dual H-bridge motor driver. Controls motor speed and direction. Allows microcontroller to handle high current loads safely. Provides stable motor control.

E.DC Motor

The RPM motor is used to drive the syringe mechanism that pushes the syringe plunger to inject antibiotics into the IV line. Features: Converts electrical energy into mechanical motion. Provides controlled rotational movement. Supports precise medication delivery. Speed can be adjusted using the motor driver.

Figure 5.3 RPM Motor

F. Syringe Mechanism

The syringe mechanism is the mechanical system used to inject antibiotics into the IV line when the system detects abnormal patient conditions. Features: Enables controlled antibiotic delivery. Connected to a motor-driven system. Ensures accurate medication injection. Supports automated operation.

G. Power Supply

The power supply provides the necessary electrical energy required for all the electronic components to operate properly. Features: Provides stable voltage and current. Ensures continuous system operation. Prevents damage due to voltage fluctuations. Powers microcontroller, sensors, and motors.

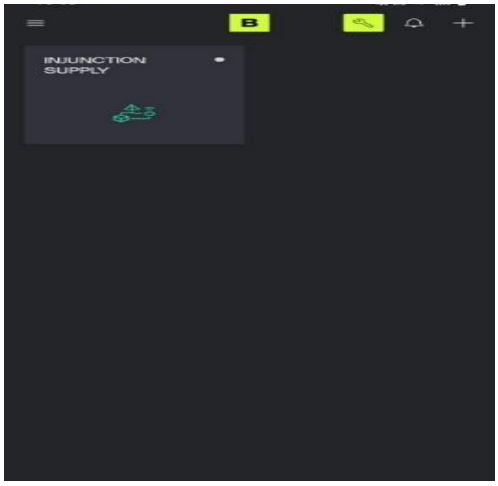

Figure 5.4 Power supply

Figure 5.5 Transmitter

VI.RESULTS & DISCUSSION:

During testing, the sensors connected to the microcontroller successfully collected the patient's health data and transmitted it to the IoT monitoring system. The temperature and heart rate sensors accurately detected changes in the patient's condition. The microcontroller processed the sensor data in real time and transmitted it to the IoT platform or mobile application through the wireless communication module. The data transmission process was stable, and the system was able to continuously send patient health information without interruption.

Figure 6.2 Receiver

In the receiver section, the microcontroller analyzed the received sensor data and compared it with the predefined threshold values stored in the program memory. When the patient's body temperature exceeded the normal limit, the system automatically activated the IV antibiotic injection control mechanism. The IV flow was regulated carefully to deliver the required dosage of medication. At the same time, the system successfully sent alerts and notifications to the doctor or caregiver through the mobile application, allowing remote monitoring of the patient's condition.

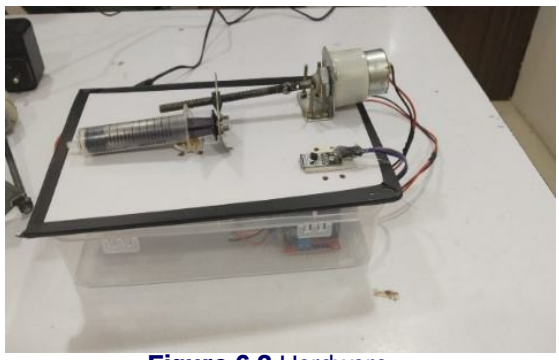

Figure 6.3 Hardware

The hardware implementation of the system demonstrated stable and reliable performance during continuous operation. Multiple tests were conducted to evaluate the accuracy of sensor readings, communication reliability, and the response of the IV injection control mechanism. The sensors, microcontroller, and communication modules worked together effectively without any data loss or communication errors. The system also ensured safe operation through dosage control and IV fluid level monitoring features.

The results confirm that the proposed system successfully achieves its main objective of providing automated and IoT-based monitoring and control of IV broad spectrum antibiotic injection supply. This system is especially useful for elderly patients and critical care situations, where continuous monitoring and timely medical response are required. Overall, the results validate the effectiveness, safety, and practicality of the proposed healthcare monitoring and automated drug delivery system.

CONCLUSION

The IoT-based IV broad spectrum antibiotics injection supply system provides an efficient and reliable solution for automated drug delivery and patient monitoring in healthcare environments. The project successfully integrates IoT technology with medical infusion systems to ensure accurate dosage control, continuous monitoring of patient parameters, and real-time alerts to healthcare providers. This system reduces human errors, enhances patient safety, and improves treatment effectiveness by enabling timely administration of antibiotics. Additionally, remote monitoring and data logging help doctors make informed decisions and provide better medical care, especially for elderly and critical patients. Overall, the proposed system demonstrates a cost-effective, smart, and scalable healthcare solution that enhances automation, accuracy, and efficiency in modern medical treatment, with potential for further improvements in advanced healthcare applications.

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