Smart Intravenous Drip Infusion Monitoring and Health Information System

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ABSTRACT: In hospitals, particularly in ICU cases, the regulation of fluids into the bloodstream is crucial and is typically managed using a drip. The maintenance of a constant inflow of fluids requires regular monitoring or replacement of the drip. The responsibility of monitoring the drip position usually falls on nurses or other healthcare providers in most hospitals. However, due to their busy schedules, they may forget to change the bottle at the appropriate time, leading to potential problems. To address this issue, an Automatic Drip Examiner System is proposed in this paper to simplify the process of measurement and eliminate the need for manual monitoring. Furthermore, Electronic prescribing is an essential component of the healthcare system that improves the safety and quality of the prescribing process. By allowing doctors to send prescriptions electronically to the nurse station, e-prescribing reduces prescribing errors and increases efficiency. This paper presents a solution to the manual monitoring of the drip and streamlines the prescribing process, making it easier for nurses to perform their duties in the hospital.

Keywords: Smart drip monitoring System, Alert message, E-prescription, prescribing errors, Data sharing.

I.   INTRODUCTION
The automation of health monitoring has had a significant impact on the medical field by ensuring patient safety and reducing stress for caregivers and nurses. In the case of intravenous therapy, which involves the direct injection of fluids into a patient's vein through an IV tube, improper care can worsen the patient's condition. To regulate the infusion setup, a bottle containing the necessary fluids is hung above the patient's body to allow gravitational energy to create pressure that overcomes circulatory pressure. However, the manual drip monitoring system used to regulate the flow rate is prone to human error, as nurses and caretakers must approximate the time it takes for a bottle to clear and make regular rounds to check the flow rate. To address this issue, an automatic intravenous drip monitoring system is proposed, which sends an alert to the assigned nurse when the fluid level in the bottle reaches a certain limit. The system measures the weight of the saline bottle using a load cell and sends an alert signal to the nurse station in real-time. The introduction of electronic prescribing or "e-Prescribing" can also improve healthcare quality and patient safety by reducing medication errors. E-Prescribing allows doctors to enter prescription information into a cloud-based system, ensuring that patients receive the right medication at the right time.

II.   EXISTING SYSTEMS
A low power circuit for medical drip infusion monitoring system[1]. This system proposes a low power medical drip infusion monitoring method that outlasts other designs. It involves multiple drip infusion monitoring nodes and a central monitoring center that communicate via a Zigbee wireless network. The examiner node uses a capacitive detector that detects the difference between air and water as distinct dielectric materials, with minimal power consumption. By detecting the status of the drip infusion tube, the examiner can send an alarm message to the monitoring center when there's no water in the tube, allowing nurses to address the issue quickly and efficiently.

An IoT Based Intravenous Drip Rate

Controlling and Monitoring Device [2]. This system describes that of the most effective means of medicine administration in any healthcare setup is intravenously. Intravenous mode facilitates fastest delivery of drug and ensures fluid replacement all through the body. Being intravenous drip set up for medicine administering is manually controlled and isn't accurate. Also, the incapability of doctors to enter radioactive checkup chambers to cover the IV drip setup is an age-old problem associated with the being system. The need for a device made to answer all these issues is linked, which can also break another major problem i.e., patient anxiety. A methodical clinical absorption and check was

accepted and compliances made during this exercise led to the offer of an alternate effective drip rate controlling and covering device grounded on IoT. The proposed new device intends to resolve the major issues similar as air embolism and blood backflow. Apart from this, it can also give effective medicine administration at precise intervals in neonates and pediatric subjects.

Real time drip infusion monitoring through a computer vision system[3]. The administration of fluids through IV infusion is a common practice in hospitals. To ensure the safety of patients, it is crucial to monitor the rate of fluid flow as both over-infusion and under-infusion can have severe consequences. This paper proposes a new system for monitoring the inflow rate of IV infusions that employs deep learning computer vision techniques. By filming the drip chamber and using object detection to count drops, this system is less intrusive than other methods. Experimental results indicate that it can accurately estimate the real-time inflow rate of the drip. As a result, this system can be effectively implemented to support monitoring and control systems in healthcare facilities.

III. PROPOSEDSYSTEM

In hospitals, caretakers and nurses continuously monitor intravenous drips. Our system is designed to keep track of the IV fluid levels within the bag and generate an alert for medical staff. The fluid levels are displayed on a graphical chart that can be accessed by nurses at the nurse station via a webpage. Furthermore, utilizing the ThingSpeak cloud, physicians have the option to transmit a patient's prescription to the nurse station via the webpage.

To determine the initial capacity of the fluid in the IV drip, the system employs a Load Cell for measurement. The fluid level is then displayed on the nurse station's graphical chart.

Once the fluid starts flowing, a Load Cell connected to an HX711 measures the data, which is then sent to the microcontroller. The HX711 converts the analog data to digital, which is displayed on an LCD. The level is continuously monitored on the web interface through ESP8266. If the value reaches 25%, the buzzer generates a sound until the nurse changes the fluid. The relay module will assist in stopping the fluid flow through the use of a solenoid valve.

To achieve E-prescription functionality, we use the ThingSpeak cloud. After creating a ThingSpeak channel, the data can be written, analyzed, and visualized in the channel. Then the data can be accessed through the webpage.
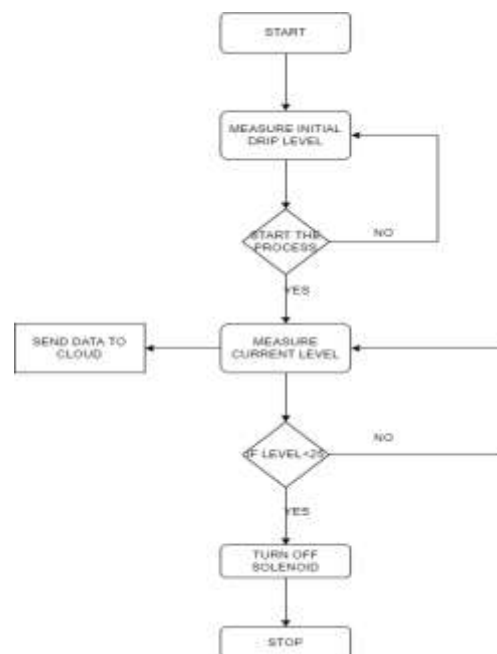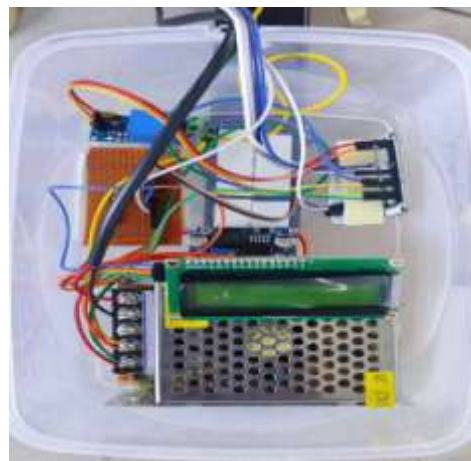

Fig.1: Flow chart of the proposed system.

Fig.2: Components of the proposed system.

HARDWARE DESCRIPTION
  i. NodeMCU

Fig.3: NodeMCU

Fig.3 is an open-source firmware and development kit that enables rapid IoT (Internet of Things) project rapid prototyping. It is based on the ESP8266 Wi-Fi module and features an integrated USB-to-serial converter, making programming and uploading code easy. NodeMCU supports Lua scripting language, which allows developers to easily create interactive applications for IoT devices. The board also comes with a variety of hardware interfaces, including GPIO pins, I2C, SPI, and UART, making it highly versatile for a wide range of applications. NodeMCU is an affordable and accessible solution for developers who want to create connected devices quickly and easily.

  ii. Switched-Mode Power Supply (SMPS)

Fig.4: SMPS

Fig.4 is an electronic circuit that converts input power from a source like a wall outlet into a regulated affair voltage. Unlike direct power inventories that use a motor to step down voltage, SMPS circuits use high-frequency switching to convert the input power into a high-frequency AC signal. SMPS circuits are extensively used in electronic bias and appliances due to their high effectiveness and compact size. They're generally set up in computer power inventories, boxes, audio amplifiers, and other consumer electronics. SMPS circuits are also used in artificial operations similar to motor drives, welding machines, and power distribution systems.

  iii. Solenoid valve

Fig.5: Solenoid valve

Fig.5 is an electromechanical device that controls the flow of liquid or gas through a tube or pipe. The solenoid valve comprises a movable plunger or piston enclosed by a coil of wire known as the solenoid. Upon applying an electrical current to the coil, it produces a magnetic field that attracts the plunger or piston towards it, causing the valve to either open or close. The configuration of a solenoid valve can differ based on the intended use and the fluid type that is being regulated.Some valves use a diaphragm instead of a plunger or piston, while others may have multiple ports to control different fluids' flow.

  iv. Load Cell

Fig.6: Load Cell

Fig.6 is a type of transducer that's used to convert force or weight into an electrical signal. The load cell is generally made up of a metal body with strain gauges mounted outside. When an external force is applied to the load cell, it causes the metal body to distort slightly, which in turn causes the strain gauges to change resistance. The change in resistance is also converted into an electrical signal that can be measured and analyzed.

Load cells can be used in a wide range of operations, including weighing scales, material testing machines, and industrial automation systems.
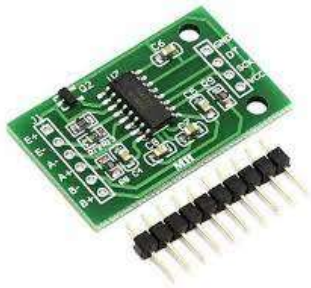
v.   HX711

Fig.7: HX711

Fig.7 is a precision analog-to-digital converter (ADC) designed for weigh scales and industrial control applications. It is capable of converting signals from load cells and other high-resolution sensors with high accuracy and stability. The HX711 uses a two-wire serial interface to communicate with a microcontroller or other digital device. It features a 24-bit delta-sigma ADC with programmable gain amplifiers and an onboard oscillator. The device also includes a power-down mode for low-power operation and a programmable digital filter to reduce noise and improve measurement accuracy.

vi.   LCDDisplay

Fig.8: LCD Display

Fig.8 consists of several layers, including a backlight, a polarizing filter, a layer of liquid crystals, a color filter, and a glass substrate. The backlight is usually composed of fluorescent lamps or LEDs that illuminate the screen from the back. The polarizing filter is placed in front of the backlight and helps to control the polarization of the light. The molecules within the liquid crystal layer align themselves in a particular manner upon the application of an electrical current, thereby enabling the passage or blockage of light.By controlling the voltage applied to different parts of the screen, the LCD can produce different colors and shades of gray.

vii.   Buzzer

Fig.9: Buzzer

Fig.9 is an electronic component that converts electrical energy into sound energy. A common configuration includes a magnetic core, a coil of wire, and either a diaphragm or piezoelectric element, as well as a driver circuit. Upon supplying an electric current to the coil, a magnetic field is generated, causing the diaphragm or piezoelectric element to oscillate and emit sound waves in the air. By regulating the frequency and magnitude of the electric signal delivered to the coil, the driver circuit enables the creation of various tone and volume combinations.

SOFTWARE DESCRIPTION
i.   Thing Speak

Fig.10: ThingSpeak

The platform is cloud-based, meaning that all data is stored and processed in the cloud, allowing for easy access and analysis from anywhere in the world.

One of the main features of ThingSpeak is its ability to seamlessly integrate with a wide range of IoT devices, including sensors, actuators, and other types of hardware. In addition to its data collection and analysis capabilities, ThingSpeak also provides a range of tools for visualizing and sharing data. Users can create customizable

dashboards that display real-time data from their devices, as well as historical data for analysis and trend identification. Data can also be shared with other users, either publicly or privately, depending on the user's preferences.
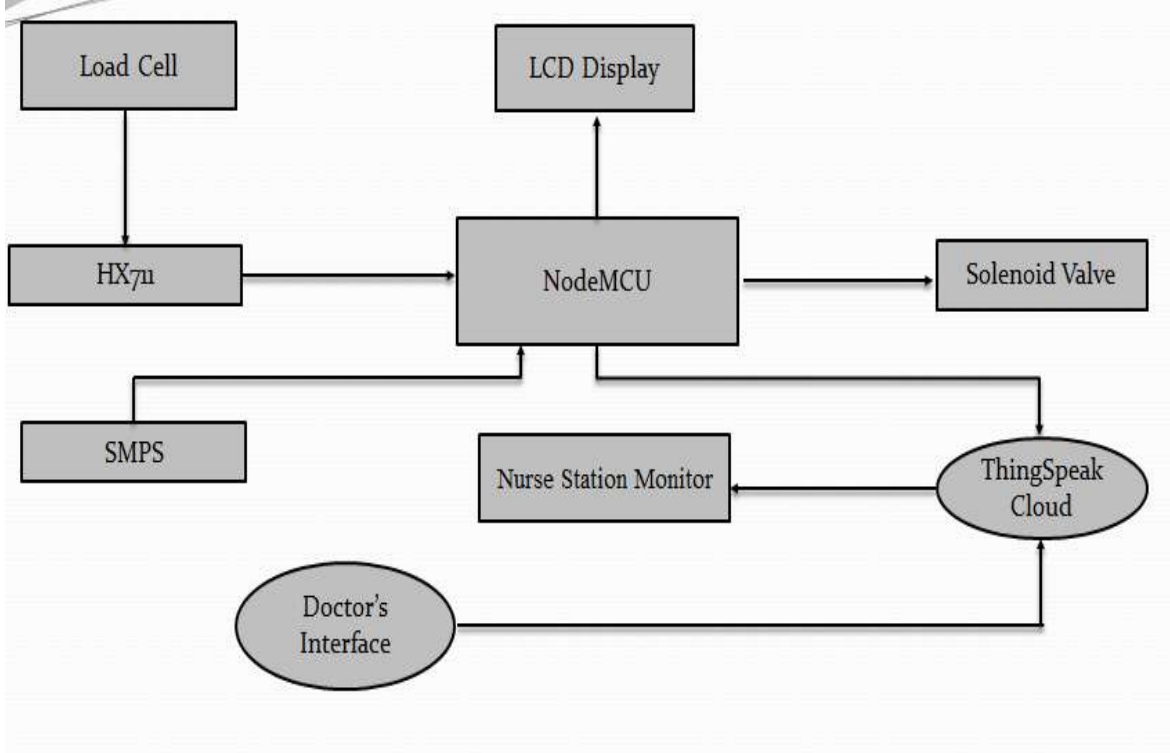
SYSTEM BLOCK DIAGRAM

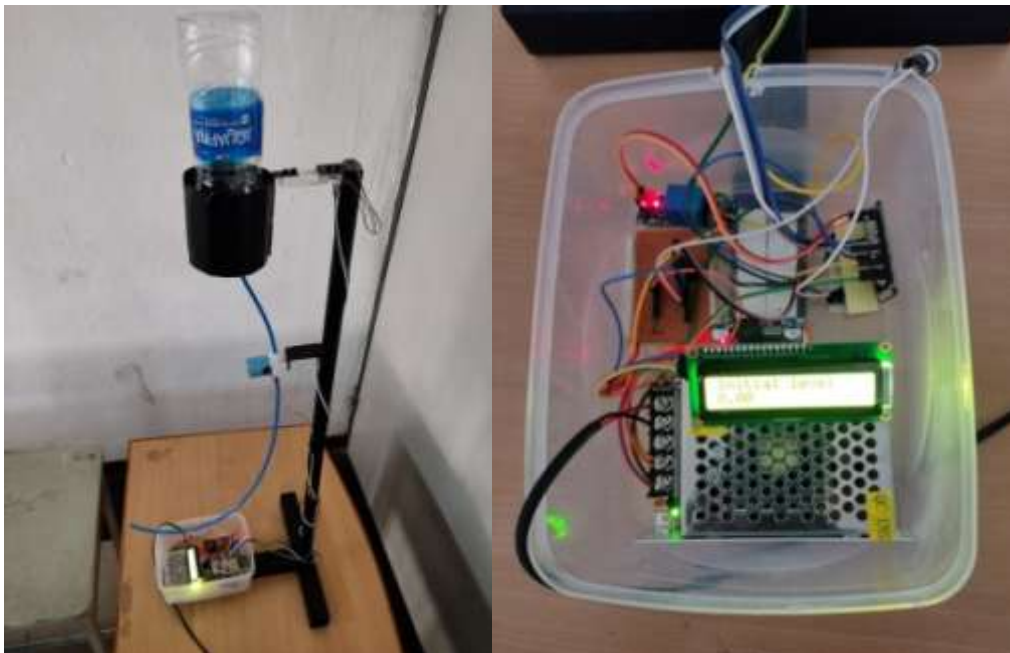Fig.11 Block diagram of Proposed System

RESULTS

Fig.12: Model of the proposed system   Fig.13: Initial level of the IV drip, before placed in the IV Stand.

Fig.14: Level of the IV drip after placed in the IV stand

Fig.15: The graph of the IV drip level and E-prescription which will display in the Nurse station.

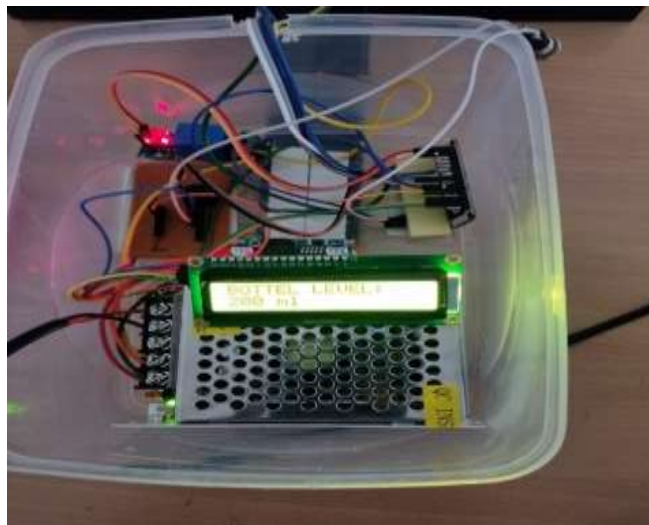Fig.16: The remaining level of the IV drip which will displayafter the flow begins.

Fig.17: When the drip level reaches 25%, the buzzer   generates the sound and the flow will cut off by the solenoid valve.

IV.   CONCLUSION

The Smart Drip Infusion Monitoring and Health Information System offers numerous advantages to patients, healthcare providers, and the overall healthcare system.By monitoring drip infusions in real-time, patients receive the appropriate amount of medication and reduce the risk of complications. This system also provides healthcare providers with valuable information to make more informed decisions and improve patient outcomes. Additionally, by using technology to improve the efficiency of healthcare delivery, this system helps to reduce costs and improve the healthcare quality. In general, the proposed system a Smart Drip Infusion Monitoring and Health Information System can be a valuable tool in improving the health of the patients.

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