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I.V Backflow Prevention Device-Medical Assistance System

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Abstract

Our paper aims to revolutionize the way intravenous (IV) blood flow is monitored and managed during infusion therapy. Our solution is a wireless IV drip detection device which is equipped with an intensity sensor on the IV infusion sleeve. This innovative device is designed to monitor the presence of the dripping, reduces the risk of complications of back flow of blood, and provide real-time monitoring of patients receiving IV therapy. The photovoltaic system in the device automatically detects the dripping of the IV drop through the tube, through the intensity variations and sends the sensor data to a remote server using web services like AWS IoT or Google Cloud IoT. Our wireless IV drip detection device, combined with our real-time monitoring system and technology stack, provides a comprehensive and efficient solution for healthcare facilities.

Keywords: Wireless IV drip, infusion flow rate, IV drop detection, IoT.

INTRODUCTION

Hospitals usually use the intravenous drip system for patients who are malnourished, dehydrated, or unable to swallow pills. To monitor the patients in hospital by using our current medical care system is a laborious task. Sometimes, medical professionals like nurses or doctors are too busy to follow every patient. When the drip system is not removed from the patient on time, problems like blood loss due to backflow will be caused. This leads to numerous issues. We presented a system called IoT BASED wireless IV drip detection device to lessen the labour of nurse staff and to resolve such a serious challenge in the domain of a drip system [1]. It has the potential to maintain patient's health and safety while enabling medical professionals and nursing team continue providing excellent treatment. The device is a perfect choice for medical institutions because it is portable, lightweight, and easy to use. The IV drop bottle or drip bag level is automatically detected by the device's photovoltaic system, which then uses online services like AWS IoT or Google Cloud IoT to store the sensor data to a distant server [2]. A web application made with a platform like Node-RED or Losant facilitates this real-time monitoring mechanism. The online application incorporates an alarm system that, in the occurrence of a flow interruption, notifies users through email or text message. Nursing staff can access the monitoring system through a website or mobile app, enabling them to monitor many patients simultaneously—even in an emergency [3]. Both the patient and the nursing team will have an effective experience due to the technology in our stack. This promotes a sustainable

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healthcare system by enabling the nursing staff to supervise several patients concurrently in emergency scenarios.

Existing System

To prevent blood from the patient flowing back into the saline bottle, the old approach required a nursing staff to monitor the level of the saline bottle continuously. The intravenous fluid flow rate is controlled by the prior system's roller clamp mechanism [4]. If the nursing staff takes too long to discover the flow rate, it could result in dangerous backflow of patient blood.

Proposed System

To prevent backflow of blood from the patient to the saline bottle under the old approach, a nursing staff member had to continuously check the level of the saline bottle. Earlier systems used a roller clamp mechanism to regulate the IV fluid flow rate [2]. The harmful backflow of blood from the patient will occur if the nursing staff takes too long to recognise the flow rate. It will notify the medical staff if there are any impending dramatic changes. The system will use a buzzer mechanism and a messaging function for alerting using online services like AWS IoT or Google Cloud IoT. Our goal was to make technology more accessible to regular people in the hospital and in society.

HARDWARE COMPONENTS

NodeMCU v3

The NodeMCU is selected for our prototype as shown in Figure 1, because due to the following features:

- It is open-source platform for IOT.
- It has on chip ESP8266.
- It has easy firmware.

The data which is collected from the sensor is driven by this NodeMCU which has connectivity to the cloud services for data monitoring and for alarm events.

Figure 1. NodeMCU v3.

LDR

The LDR (Light Dependent Resistor) sensor is used to detect the intensity of the light. The LDR is integrated with the NodeMCU and the intensity of the light variation is continuously monitored during the drip.

LED and BUZZER

The LED and BUZZER is used for alarming the nurse locally. The LED is used as a visual signal and the BUZZER is used as an audio signal.

BLOCK DIAGRAM

Working

Intravenous (IV) blood flow management and monitoring during infusion therapy are two areas where our firm seeks to make a significant impact. Real-time monitoring of patients getting IV therapy is provided by this cutting-edge technology, which is also intended to monitor the presence of drip, lower the risk of problems, and deliver these benefits. In the above setup as shown in Figure 2, the drip is a small plastic tube placed between a led and LDR sensor (as shown in Figure 3). As the drips flow, the intensity of variations is observed. A LDR sensor monitors the change in intensity that is emitted from LEDs and send it as an input to an Arduino. The Arduino is programmed to sound a buzzer if the intensity of variations lasts shorter than 20 seconds as shown in Figure 4. For the drip to be complete, either the backflow must be started, or the drip liquid must be completed.

Figure 2. Experimental setup.

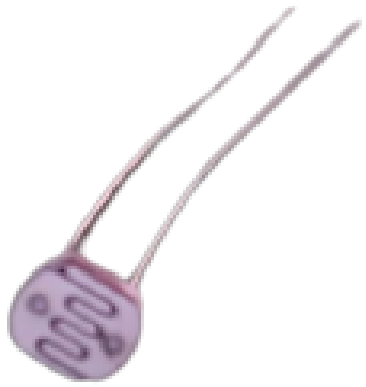

Figure 3. LDR.

Figure 4. LED.

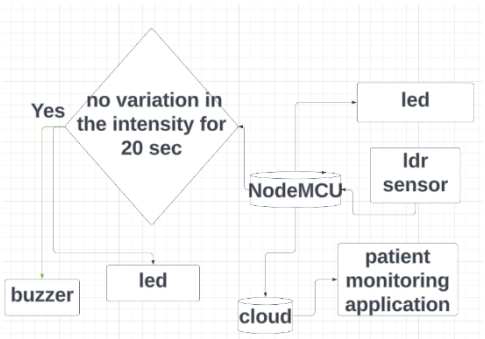

Figure 5. Block diagram.

It is the perfect equipment for healthcare establishments because it is lightweight, very portable, and easy to use. Using online services like Amazon IoT or Google Cloud IoT, the photovoltaic system in the device automatically determines the the absence of drip in the bottle. The complete process is represented as a flowchart in Figure 5.

As a result of variations in light intensity, waveforms are observed. Drip injections into the human body produce a high intensity when injected normally. This can be verified in Figure 7. It is agreed that the backflow issue is avoided when intensity variations are small which is observed in Figure 8.

WORKING CONDITIONS

In our system a little plastic tube is sandwiched between an LED and an LDR sensor. The intensity of fluctuations is seen as the drips flow. An Arduino receives information from the LDR sensor about the brightness of the light that the LEDs are emitting. The LDR sensor doesn't rely on the availability of natural light to produce its data. The I.V. Backflow Prevention System for Nurse Assistance will produce the same results day and night.

PROGRAM

Our program is improvised to meet the different environmental conditions, whenever the device is activated the intensity in the environment is taken and set as a threshold value. And the variance of the

intensity on the presence of the drip is calculated and the accuracy of the output is improved. When the drip interrupts the intensity the internal clock timer resets to zero and when there is no interrupt for 20 seconds and also the internal clock timer attains 20 and thus the alarm goes on as the serial data is shown in the Figure 6. And, the sensor data could be uploaded to the cloud.

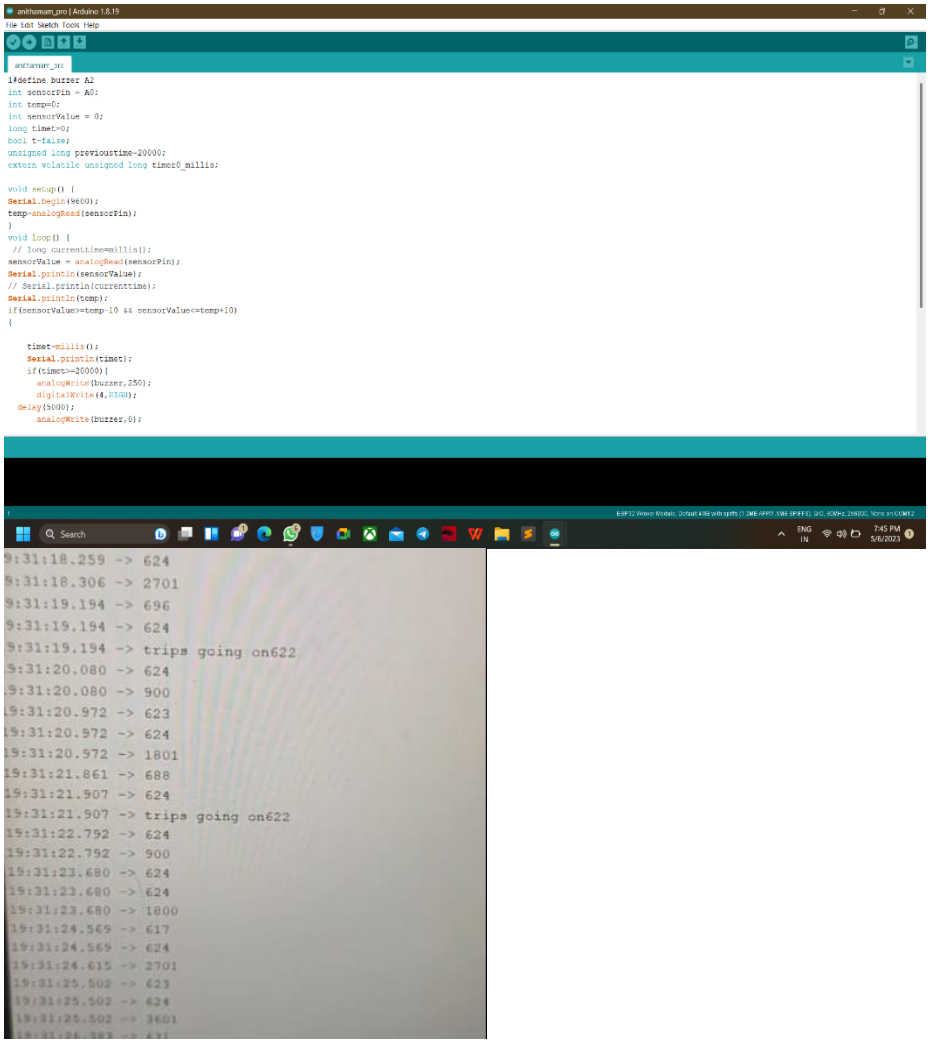

Figure 6. Observing The Variations Through Serial Monitor.

RESULTS

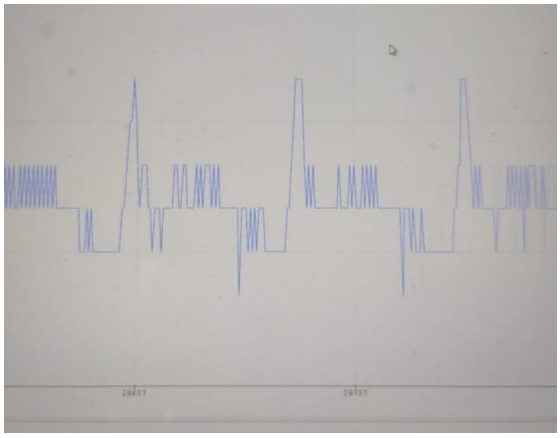

Figure 7. Intensity variations.

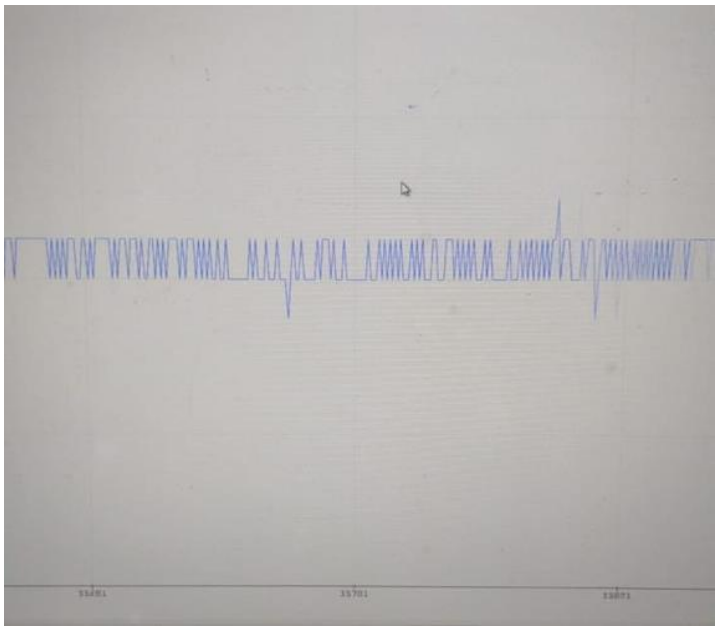

Figure 8. Intensity variations.

APPLICATIONS

1. *Integration with Electronic Medical Record (EMR) System:* To offer a more thorough level of patient care, the device may be integrated with the hospital's EMR system. The nursing staff would be able to view a patient's IV therapy history and other relevant medical data, as well as receive notifications for possible drug interactions or other pertinent information, thanks to this connection.
2. *Mobile App:* A mobile app for the IV Backflow Prevention Device could be created to let patients track their own IV therapy in real-time. Patients could receive notifications for potential issues or consequences as well as information about their treatment plan, including dosage and infusion rate, through the application.
3. *Improved User Interface:* The NodeMCU is very much user friendly and handy for nursing staff. This could include features such as touch screen displays, voice-activated controls, and customizable alert settings.
4. *Integration with Smart IV Pumps:* To create a more complete IV therapy management system, the IV Backflow Prevention Device may be integrated with smart IV pumps. Smart IV pumps would make it possible to control IV therapy more precisely and automatically, and they might also be able to give the device more information to enhance its monitoring and alerting capabilities.

CONCLUSION

Normally, the nurse or doctor regularly monitors the saline flow and stops it when the drips end for a patient, but it can be challenging when there aren't enough nurses and those that are present must stand next to the patient to monitor the IV bag. In our suggested I.V BACKFLOW PREVENTION DEVICE FOR NURSE ASSISTANCE SYSTEM, the brightness of visible light emitted by the LED is sensed by a light sensing circuit with the help of LDR sensor [5]. Our device will determine when the drip bottle's liquid is almost drained when the light intensity changes. When the IV infusion is over, medical personnel can help the patient right away. Nevertheless, the suggested system is only available in its most basic version at this time [6]. Future development will focus on making the system portable, cost-effective and secured with regard to the communication to distant server for storing the data in cloud platform for initiation of action from anywhere using IoT [7]. Monitoring during the night shift will be more advantageous using this approach.

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