Digitization of Motor Driven Intravenous Pump for Drug Delivery System based on IoT to Aberrant and Persistent Patients.

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Abstract— This system introduces a unique method for operating a syringe pump through a smartphone application. Tailored for both acute and chronic patients, this pump boasts enhanced functionalities, including a built-in temperature sensor for patient monitoring. Harnessing the power of the Internet of Things (IoT), the model grants remote pump control, further functioning as a real-time dosage tracker to guarantee precise drug administration based on individual needs. By automating processes, this pump significantly lightens the workload of medical staff. Moreover, it integrates an alert system to ensure prompt response to patient discomfort, such as shivering. This innovative solution facilitates the delivery of fluids in minute amounts, while simultaneously alerting staff via an audible buzzer in case of patient discomfort.
Keywords— Arduino Uno, Infusion Pump, Internet of Things (IoT), Telemedicine, Android app
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I. INTRODUCTION

The internet of things (IoT) refers to a network of tangible terms, including devices and other entities embedded with software and sensors. These components enable the seamless collection and exchange of data amongst themselves. Utilizing this technology allows object to be anticipated and controlled remotely. The concept of interconnected devices involves gadgets equipped with computational capabilities, software and other technologies, facilitating their connectivity and data exchange with other devices.

An infusion pump is a medical equipment which is used to deliver fluids like nutrients and medications to the patient's body in a precise amount. A syringe pump serves as a compact infusion device utilized for precise administration of small doses of prescribed medications or solutions in medical and research contexts. It accurately dispenses fluids, proving especially beneficial for prolonged liquid medication needs in children. Manual infusion, linking syringes to catheters or pumps, is facilitated by syringe pumps, allowing unattended infusion. These pumps come in various designs like syringe, peristaltic, and piston pumps, each with distinct flow rates and precision capabilities.

Syringe pumps use a worm-drive mechanism to control the plunger's movement. Two common types are medical infusion pumps, providing controlled fluid delivery for patients receiving nutrition, medications, or blood, and research syringe pumps, tailored for precise fluid delivery in laboratory settings. While medical pumps prioritize simplicity and may have lower precision needs, research pumps excel in delivering highly accurate and minute fluid fractions.

The core component of a syringe pump is, unsurprisingly, the syringe. Originally prevalent in medical settings, the syringe relied on manual piston movement, lacking regulation for controlled administration. The syringe pump was developed to address this limitation, offering a linear motion mechanism that regulates piston speed.

The pump adjusts its linear velocity based on the desired flow rate when the syringe diameter is known. A key advantage lies in the user's ability to easily adjust the operating range by changing the syringe diameter.
In manual method flow rate depends upon the following equation,
Flow rate= (volume*drop factor)/Time (1)

II. LITERATURE SURVEY

1. A. INTAVENOUS DRIP MONITORING SYSTEM FOR SMART HOSPITAL USING IOT

In the existing healthcare system, the supervision of patients in a hospital throughout the day is a weary process. At times, medical professionals are too occupied, leading to the inability to oversee each patient adequately. This results in various complications, and the healthcare tasks must be carried out accurately. A case in point within hospital involves administering saline or intravenous (IV) fluids into the patient's vein. If the drip system is not vigilantly observed, it can lead to issues such as fluid backflow and blood loss. To alleviate the workload and address critical situations in IV monitoring this method is have been implemented.

B. LOW-COST DIGITIZATION OF INFUSION PUMP FOR REAL TIME AUTOMATED FLOW RATE MONITORING AND WARNING

The population of the world has been increasingly exponential. To address this issue, there is a pressing need for health surveillance devices. Novel health monitoring systems are essential, featuring minimal human involvement and affordability, catering to both rural and urban areas. The suggested apparatus comprises an Arduino UNO, infrared sensor, ESP8266, Keypad, and LCD. This device empowers doctors or nurses to effortlessly oversee saline levels, drop rates, and the composition of the current solution in the IV bag. Automatic notifications are sent to the nurse's computer or mobile device, accompanied by LED indicators on the device itself. Ultimately, the proposed apparatus is designed for reuse.

C. IoT BASED MOBILE APPLICATION FOR SMART INSULIN REGULATION

The advancements in glucose monitoring for diabetic patients, focusing on both invasive (finger-prick) and non-invasive techniques. Optical and transdermal approaches show promise in non-invasive monitoring, utilizing IR radiation to measure glucose levels It reviews the fundamental techniques of blood glucose level detection and smart insulin regulation. In this the blood glucose level is monitored the first part is responsible for detecting the blood glucose level and receiving the determined value in the smart phone. The glucose monitoring setup is connected to the smart phone using Wi-Fi. The second part is responsible for injecting the required amount of insulin as per the instruction given from the smart phone. Based on the displayed blood glucose value, the required amount of insulin is injected, by the instruction.

D. DESIGN OF LOW-COST SMART INFUSION PUMP

A syringe pump is a medical apparatus utilized to administer medications with moderate accuracy. Intravenous drug delivery via infusion is particularly challenging for basic applications since consistent infusion flow rates are essential, as any dosage inaccuracies or delayed alerts can lead to adverse clinical outcomes. Consequently, addressing the reported issues, the study proposed an innovative approach utilizing a strain gauge transducer mechanism for infusion measurement, with flow control regulated naturally by gravity. The project incorporates simplified electronic circuits and is remotely controlled via a wireless Bluetooth module, offering significant advantages over both manual and automated fluid administration. These benefits include the capacity to deliver fluids in small increments at precisely adjusted rates, along with audible and visual alerts, cost-effectiveness, and compactness compared to traditional infusion pumps.

E. INTELLIGENT (I^2OT) BIOMEDICAL WEARABLE SYSTEM BASED ON SMARTPHONE APPLICATION

This paper introduces an innovative approach to create a portable, microliter-precise syringe pump that can be controlled wirelessly via a smartphone app developed using App Inventor. These syringe pumps are utilized by patients at home or during ambulatory care, necessitating a lightweight design and medical supervision. To achieve this, certain electronic components have been replaced with a smartphone application for managing and regulating the syringe pump. Furthermore, smartphone technology has the potential to revolutionize healthcare delivery systems by enabling remote monitoring and control. Its widespread availability allows for new applications and solutions to healthcare challenges, including remote control and big data management, alongside various network communication protocols.

F. IoT APPLICATION FOR THE DESIGN OF DIGITAL DRUG ADMINISTRATION INTERFACE

The Precision Infusion Device is an exact instrument for administering infusion-based medication to critically ill patients. It allows for precise delivery of drugs and regulates the duration of drug infusion as needed. The Internet of Things (IoT) is utilized in this project for the dual management of the infusion device. An operator can control the device manually or through our developed interface or via a dedicated mobile application, enhancing its accessibility. This project is capable of fulfilling all these functions. Additionally, the application can serve as a monitoring tool, displaying the infused volume and remaining time. This decreases the workload on hospital staff in terms of manpower and task intensity, thereby saving both resources and time

III. PROPOSED SYSTEM

A. DESCRIPTION

In similar cases examined, the level of IV fluid that delivered and control the flow rate of the IV fluid. It also involves continuous monitoring of the patient's temperature and fluid level that is delivered to the patients. In our proposed model, If there is any changes in temperature of the patient, the system alerts the staff using a buzzer. This system is also additionally added with a notification, which can be received by a smartphone application. The goal is to make this technology accessible and helpful in hospitals and the broader community.

B. BLOCK DIAGRAM OF PROPOSED SYSTEM

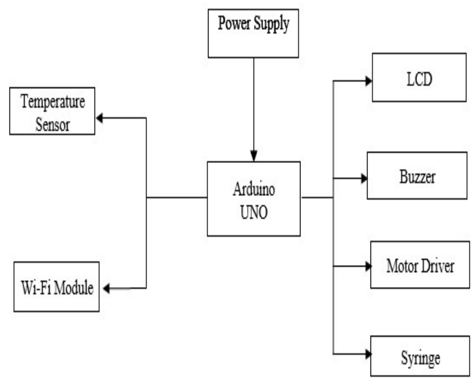

Fig. 1. Proposed System

The Arduino UNO is coded to detect the signals from the temperature sensor and transform the signal into a digital format which can be viewed in a smartphone application.

The Wi-Fi module integrated with Arduino can pair with the smartphone app. The app, used by the nurse/staff, analyses the data and make a suitable decision for the patient's safety.

C. METHODOLOGY

As in the fig. 1 which represent the basic flow of the system architecture. The IoT device acquires information from patient's body and IV pouch through the detectors and transmits the data via Wi-Fi to the application. The application is where all the data can be monitored ana analysed at real time using the mobile application. In the event the fluid level reaches an empty state, it will send a notification to the staff application. The staff can control the flow rate by analysing the fluid status. The staff can also monitor the temperature of the patient. If the patient feels uncomfortable or gets shivered the buzzer system gets activated and send a notification to the staff.

D. MODULAR DESCRIPTION

1. Sensors Detection
2. Signal conditioning section
3. Monitorization

1. Sensors Detection

a) Temperature Sensor: LM35 is a temperature sensor that outputs an analog signal which is proportional to the instantaneous temperature.

2. Signal conditioning section

a) Arduino UNO : This board can control temperature sensor, LCDs, buzzer and motors as an output. Arduino is an open-source electronics platform based on easy-to-use hardware and software

b) Wi-Fi module: The Arduino Uno Wi-Fi is an Arduino Uno with an integrated Wi-Fi module. The board is based on the Arduino with an ESP8266WiFi Module integrated.

c) Motor Driver (DC Gear Motor): A gear motor is an all-in-one combination of a motor and gearbox. The addition of a gearbox to a motor reduces the speed while increasing the torque output

3. Monitorization

The patient data is monitored and can be displayed in a smartphone application by using IoT.

IV. CONCLUSION

In conclusion, the digitization of motor-driven intravenous pumps for drug delivery systems based on IoT offers significant benefits for both healthcare providers and patients. By integrating IoT technology, healthcare providers can remotely monitor and control drug delivery, ensuring precise dosages and timely interventions. This enhances patient safety by reducing the risk of medication errors and allows for more personalized care. Additionally, IoT-enabled pumps enable real-time data collection, facilitating better treatment decisions and improving overall patient outcomes. Overall, the implementation of IoT in intravenous pump systems represents a vital step towards achieving more efficient, accurate, and patient-centered healthcare delivery.

V. FUTURE EXTRACTION

Speculate on future developments in the field, such as advancements in sensor technology, artificial intelligence for predictive analytics, and the integration of IV pump data with electronic health records.

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