# INTRAVENOUS DRIP MONITORING SYSTEM FOR SMART HOSPITAL USING IOT

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**Abstract:—**

**In our current medical care system, the monitoring of patients in a hospital throughout the day is a tiresome process. Sometimes Doctors or Nurses are too busy, so they can't monitor each patient. This causes many problems. The health related work should be properly done and that too with accurate manner. An example of such type of work in our hospital is injecting saline or Intravenous (IV) fluids in to the vein of patient. If the drip system is not monitored on time, it will causes problems like backflow of fluid, blood loss etc. In order to reduce the workload and overcome such critical situation in the area of an intravenous drip monitoring system, we proposed a system called Automated Intravenous Drip Monitoring System.**

***Index Terms*— Intravenous Drip Monitoring system; Intravenous Fluids; Injecting Saline; Backflow;Blood Loss**

## I. INTRODUCTION

Internet of Things (IoT) is defined as the network of physical objects comprise of devices, vehicles, buildings and other things embedded with electronics, software, and sensors which facilitate these objects to collect and exchange data among each other. Using this technology, objects are anticipated and remotely controlled over the existing network infrastructure. This helps us to integrate the physical world into a computer-based system. IOT make things easier and it leads to automation of daily tasks leading to a better quality of life and saves money as well as time.

Generally, as the population density increases, the emphasis of health care also increases. Hence it is a imperious thing for everyone in this world to take care of their health properly. IoT plays a major role in the health monitoring system. We can implement this technology in hospital management system, by introducing intelligent devices and subsystems, thereby hospitals can save the operation cost, strengthen the medical experience of patients and reduce the capital and labour intensity of medical staff. Nowadays, many automated health monitoring devices are evolved for patient's safety and reduces the stress of the medical staff. The discovery of these devices offers a drastic change in the medical field. It monitor the physical as well as environmental parameters like heartbeat rate, detection of heart attack symptoms, Temperature etc. Although many advanced automated devices are prevalent to ensure the safety of the patients, Monitoring patients during IV therapy is still a challenging problem. In our current medical care system, we manually do all this monitoring task. We need to alert the medical staff about the Drip level in a fimos bottle that is being injected through the patient's vein (IV therapy) and the patient condition on a real time. To implement this feature here introduces an Intravenous Drip Monitoring System (IV system).

The objective of this paper is to discuss the developmental framework for the design of IV drip monitoring system. We describe the specific characteristics of the drip system, and the services that may drive the adoption of this system by general hospital. We then overview the different modules associated with the drip system and their function. Finally, we substantiate the discussion by reporting various application associated with the system.

The rest of paper is organized as follows. Section II study five different paper related to IV drip monitoring system. Section III provides a general overview of the proposed system. In detail, this section describes the block diagram, methodology and modular description for the realization of IV drip monitoring system. Section IV presents the final output of the IV drip system. Finally Section V describes the benefit and Application of IOT which exemplifies relevance of automated system.

## II. LITERATURE SURVEY

### A. AN INTELLIGENT MEDICAL MONITORING SYSTEM BASED ON SENSORS AND WIRELESS SENSOR NETWORK

Technologies like Wireless Sensor Networks (WSN) are used to monitor vital signs of patients reported to doctors in hospital. In this paper, introduces a prototype of medical monitoring system specifically for elderly people by using technologies like REST, Jess rule engine and Android in order to cope up with future changes. Sensors and WSN based monitoring system help doctors, nurses and other medical personnel to continuously monitor patient's conditions. And it will collect physical parameters with the help of Sensors and wearable computing devices to perform data processing and transmit required data to a sink or receiver through the medium of WSN.

### B. INTRAVENOUS DRIP METER AND CONTROLLER

This project aims at creating a device which will not only monitor but also control the drip rate and provide alarms when

needed [2].The device will cater to the challenges as follows: The device will help the user to easily adjust the drip rate for different fluids and drip sets just by entering the known parameters such as volume to be infused, time in which it has to be infused, drop factor or the required drip rate itself. The drop rate will be continuously monitored and displayed for easy accessibility. The drop rate will be maintained constant irrespective of changes in fluid concentration, composition, viscosity or the amount of fluid in the reservoir or other parameters. An alarm (audible and visual) will be triggered whenever the drip chamber becomes full, drip is stopped, variations in set rate (speeded up or slowed down), pre-set reservoir level reached, reservoir low or empty, battery low, etc. The drip will be automatically shut off before the reservoir empties or once a pre-set level is reached to prevent the occurrence of air embolism and/or other complications.

### C. SMART DRIP INFUSION MONITORING SYSTEM FOR INSTANT ALERT THROUGH NRF24L01E

Drips infusion solutions are commonly used in hospitals. For infusion therapy, the infusion rate must be properly managed. Here Drop counter is used to detect the infusion rate. Infusion rate will be calculated for every one hour or 30 minutes. The system consists of eminent monitoring systems with a central monitor computer at the nurse station. By analysing standard parameters(pressure) caused by the infusion rate, the dripping solution, and information about the state of IV bag dripping, variation in flow, finished(solution bag empties) is transferred to central monitor instantly, then these data are graphically represented in the central monitor of the nurse station. The developed system can monitor the infusion status of many patients within that hospital and the information can be collected, saved in the nurse station, which helps retrieval facility for later reference.

### D. A NEW DRIP INFUSION SOLUTION MONITORING SYSTEM WITH A FREE-FLOW DETECTION FUNCTION

In some situation, patients are unable to take any liquid by mouth. In order to overcome this situation, we use drip infusion and an infusion pump for injecting fluid in to the patient body. Modern infusion pumps are very accurate, expensive and are sometimes difficult to operate. Therefore, the drip infusion technique is more generally used than an infusion pump. A drop counter is used to monitor drip rate which is attached to the drip chamber. Drop counters detect the fall of each drop of fluid using an infrared transmitter and receiver attached to the drip chamber. But, these counters cannot detect an accidental free-flow of infusion fluid, which, in effect leads to patients death.

### E. CONCEPTUAL DESIGN OF INTRAVENOUS FLUID LEVEL MONITORING SYSTEM-A REVIEW

This project concentrating on both controlling the flow rate of saline and alerting the nurses/doctors to change the bottle. Here uses a flow sensor in order to control the drip volume and it monitoring the condition of the patient, which include checking the blood flow, heart rate, and blood pressure. At first, In the PLC circuit, these constraints act as the input, they input the normal value of these constraints, and any deviation from the normal values will ultimately alert the medical professional. Secondly, the salivation circuit near the flow meter controls the amount of IV fluid to be injected in the patient. The input is the amount of saline to be injected along with the time in which the process is to be completed. This will give a value of flow rate, the same flow rate will go through the flow meter, and thus, the process will continue. After the bottle is finished, the flow meter turns off automatically and, the medical personnel is being alerted. In this way, the whole system will be automated and thereby reducing manual work.

## III.PROPOSED SYSTEM

### A. DESCRIPTION

In all the cases examined, it is realized that mass flow rate, level of the IV fluid and the patient body condition needs to be monitored at every time. However it is based on the decision of the doctor or the nurse, at what flow rate, the fluid is to be injected based on patient condition. In our proposed model, we are concentrating on both controlling the flow rate manually by making use of a mobile app, monitor level of IV fluid in the bag and give warning to the medical personnel to change the bottle. Similarly, the subsequent phase that comes is the regular Monitoring of individual state. For this, we will steadily monitor the heart rate, BP, temperature of the patient, and fluid level on the IV bottle while injecting. If abrupt changes are coming, it will alert the medical personnel. For alerting, we use buzzer technique and messaging facility. If the patient feels discomfort he can give an alert to the nurse by pressing a panic button. We aimed to bring the technology closer to common people in hospital and society.

### B. BLOCK DIAGRAM OF PROPOSED SYSTEM

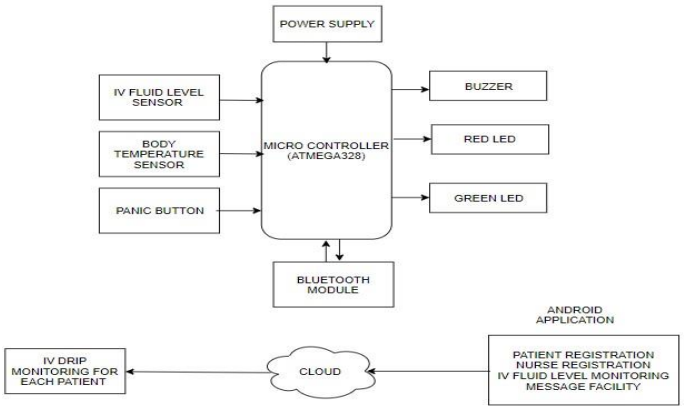


Fig. 1. Proposed System

The Arduino (ATMEGA328 Micro Controller) are programmed to perceive analog signal from the sensors and generate a data packet to convert the signal into digital form. The Bluetooth Module equipped with Arduino has the ability to conjoin with the smartphone application. The sensors collect data from the patient body and IV bag and send the information

to the application. The application carried by nurse/staff analysis the data and take an appropriate decision. So that real-time monitoring and control are possible.

C. METHODOLOGY

As in the Fig. 1 which represent the basic flow of the system's architecture. The IOT device collects data from the subject body and IV bag through the sensors and transmit data along Bluetooth to the application. The application is where all the data can be monitored and analyzed at real time using the Mobile app. The fluid level is detected by moisture sensors. If the fluid level goes to an empty state it will give alert to the nurse Mobile Application. She/he can control the flow rate manually by analyzing the fluid status. If the patient feels discomfort he/she can press the panic button to obtain the help from medical staff and an alert message/alert call is passing to the mobile app if the medical staff is far away from the patient.

D. MODULAR DESCRIPTION

The four modules used in this system are:

1. Sensors attached to the body of patient and IV Bag
2. Signal conditioning section
3. Patient monitoring system
4. Doctors/nurse mobile phone.

1. Sensors attached to the body of patient and IV Bag

Embedding the pulse sensor, temperature sensor, Blood Pressure sensor, Fluid Level sensor with the Arduino board.

a) Temperature Sensor**:** LM35 sensor is used for measurement of body temperature. The sensor is attached to the patient body and it senses body temperature. It is calibrated linearly in Celsius. It has low self-heating capability. Also, it doesn't require external calibration.
b) Fluid level sensor: The IV fluid level sensor is used to measure the IV fluid level. In the presence of water, the module output is at a high level; else the output is at a low level. We have used an NPN transistor to detect IV fluid level.

2. Signal Conditioning Section

a) Arduino Uno**:** Arduino Uno is characterised as a microcontroller board based on the ATmega328P. It encompass 14 input/output digital pins (of which 6 can be used as PWM outputs), 6 analog inputs, a quartz crystal with 16 MHz size, an ICSP header ,a USB connection, a reset button , and a power jack[8]. It incorporate everything needed to support the microcontroller and easily connect it with a computer via a USB cable and power it with an AC-to-DC adapter or battery to get started the devise.
b) Bluetooth Module**:** The Hc05 Bluetooth serial pass-through module is characterized in to two operating modes, first one is the Data mode in which it can transmit and receive data from other Bluetooth devices. Later one is the AT Command mode in which the default device settings can be changed.

3. Patient monitoring system

IOT devices regularly collect data from the users as well as environment and send it via Bluetooth medium to the application. The data like Pulse rate, BP, Temperature and fluid level are monitored at real-time. The level sensor read values and compared with threshold values or pre-set value. If it is below the threshold value it will alert the nurse or medical staff.

4. Doctors/Nurse mobile phone

The patient data is monitored and graphically displayed on mobile of medical staff. So that real-time monitoring is possible.

IV RESULTS AND DISCUSSIONS


Fig. 2. The final output IV system

The Fig. 2 describes the final output of the system. Here developed the hardware such as arduino embedded with sensor to fetch data like Fluid Level, Patient physical parameter such as BP, Temperature, Heart rate etc. The sensed data visually displayed on an android application attached with the drip system. It also contain a panic button, for which the patients can notify the nurse for urgent help by a messaging facility. All the collected data is send to the protected cloud and can be available from anywhere in the hospital by make use of an Android app. In general objective of this project that is to develop an android application displaying notification about Drip level/patient physical parameters and give alert to Nurse or Doctor if the IV bag began to empty state is obtained. It is a low cost and safety healthcare in Intravenous drip system that provide Ease of accessibility for observer/ Nurse.

## V. BENEFITS AND APPLICATIONS OF IOT

### A. BENEFITS:

In IOT we can use any device with built-in-sensors with the ability to collect and transfer data over a network without manual interference. IoT enables to access devices remotely across the internet, it allows to directly connect & integrate the physical world to the computer-based systems using the internet and sensors. The interconnection among embedded devices support automation and it also enables advanced applications in the current scenario. The major benefits of IoT are:

- **Customer Management:** Automation in the business field results improvement in customer experience. For e.g. The issues of automobile engine detection where the driver and the manufacturer are notified about it.
- **Optimization Techniques:** The drastic change of technology optimizes the power and energy consumption. The Car manufactures can collect data from different car sensors and analyze them to improve their design, performance and make them more efficient.
- **Waste Reduction:** The waste reduction and reuse is possible by better decision and management.

### B. APPLICATIONS

- **Power Applications:** The power consumption has lifted to a great extent. IoT devises monitor the energy usage at the appliance-level, house-level as well as distribution level. Smart Grid or controllers & Smart Meters are used to supervise energy consumption.
- **Application in Healthcare:** The use of smart watch, fitness devises improves health of individuals [6]. The emergency situations of patients coming through ambulance is handled and monitored by doctors through online media [9] and analytical techniques.
- **Education:** The educational tools and materials which helps in filling the gaps between education industries. It optimizes the cost, improves the quality of education and also improves the management decisions making process by taking student's response and performance into consideration.
- **Government:** Governments funded projects are used to build smart cities using IoT. The armed force systems and services are being realized by augmented techniques and it provide high performance.
- **Air and Water Pollution control measures:** The various sensors and devises are used to detect pollution in the air, soil and water by frequent sampling and testing. This will help in preventing contamination and diseases propagation.
- **Transportation:** The drastic improvements in transportation and logistics management result in efficient infrastructure development in our country. Now, we have self-driving cars, automatic traffic light, automatic parking assistance.

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## VII. CONCLUSION

In this system, here reviewed the functioning of an IV drip system and its associated risks. Here we knock down an actual problem that is the real time patient's monitoring. As the home care is becoming a part of our normal routine of life, i.e. taking care of elderly persons or people with chronic diseases etc. Our proposed system addresses all this problem. The essential part of our system is : Installing hardware as well as software sensors, retrieving and storing data in a database server, and processing this data to automate the drip monitoring system. This system which integrates a lot of features from the existing independent system and has also added some key features which are supposed to change the scale of the practicality of the system. Use of such a device will reduce the complications associated with IV drip usage in hospitals.

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