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# IV Therapy Control with IOT and LABVIEW

**Avinash. K[1*], Akash. S[2], Raja. M[3], Arunganesh. K[4]**

[1, 2,3] *Student, Dept of EEE, Periyar Maniammai Institute of Science and Technology, Thanjavur, TamilNadu, India.*
[4] Assistant *Professor, Dept of EEE, Periyar Maniammai Institute of Science and Technology, Thanjavur, Tamil Nadu, India.*

[*]Corresponding author
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## Abstract

Load cell sensors are used to measure the amount of intravenous fluid in the container, whether it is Full or Low with warning status, as part of an automatic intravenous fluid administration and management utilizing IoT saline level monitoring system. The load is detected in analogue format. The LCD display shows the output that was acquired from the sensor. The alert will ring when the saline level falls below a predetermined level. As a result, the flow rate may be managed by the physician both manually and automatically utilising IoT and input sensors installed on patients and visually presented in LabVIEW software.

**Keywords:** IoT, Solenoid Actuators, Heartbeat sensor, LabVIEW, Fluid flow sensor.

## 1. Introduction

Modern solutions are always needed for modern issues. a system that saves lives. This study suggests a proof-of-concept system that delivers continuous infiltration monitoring near the IV catheter site using level sensing with no pain and a lower power processing platform. This kind of system could be able to detect an infiltration non-invasively monitoring for known symptoms: swelling of soft tissue and increased skin firmness; these symptoms can be sensed by measuring skin stretch and local bioimpedance. This project was created as an automation programme with the intention of assisting nurses and carers. The nurses can able to handle a large number of patients in an hourly manner when this project is implemented.

Adequate hydration via a saline drip is essential during surgery, but recent reports suggest that getting the balance of salt and water just right could have an important impact on patient recovery. This Intravenous Drug administration includes various drugs namely saline, plasma, blood and all the other haemolytic diagnosis .it is necessary to find the reasons for the intravenous infusion process. So that any underlying conditions that can impact patients throughout the infusion process, such as respiratory problems, anaemia, or long-term nausea, can be examined. The Intravenous fluid plays an important role in maintaining a good blood flow and liquid movement after the patient is identified as weak. The IV fluid reduces the complication of water retention on the underlying tissues causing unwanted issues on the body of the patient The nurses who are working over time should have to care themselves so our project gives every minute details in perfect to the last patient if the patients are in a larger numbers, it requires a lot of nurses and care takers to be in the times of emergency as we all know that in the year 2020 the COVID 19 affected the entire globe causing a large no of casualty . thus, it is necessary to hold a larger work strength to handle that much of people with less work power. If we use a network of this project, we can able to monitor all the patient's data in a single window as it can be beneficial fora higher patient to nurse ratio or more patients in the absence of more nurses. For those with less technical understanding, the LabVIEW is really beneficial. This initiative may therefore be easily recognised by everyone worldwide without any communication barriers.



Health care has to be improved as a result of the growing population. As the saline bottle goes below the threshold level, it is necessary to change the saline bottle. So new idea called LabVIEW-based Saline Level Monitoring System is emerged. The major goal of the system is to produce a reliable, simple, affordable, and accessible solution for saline level monitoring. Saline is injected into the blood while taking into account the patient's body weight, heart rate, blood pressure, temperature, and pulse. So, nurses do not need to go to patient's bed every time because they can check amount of Fluid injected into each patient via this system. This system is a low-cost system and comfortable for a nurse. As a result, it was installed in isolated settlements so they could use it to deal with potential problems. Initially, this might be inferred as an event. But the consequences are harmful. When the IV bottle. Thus, Unique health monitoring systems have been developed with less human interference which will be available at low cost in remote areas as well as highly populated areas. The system objective is to trouble-shoot the above-mentioned problem efficiently. The nurses can monitor how much IV fluid is left even from the control room using this method. The load weights the bottle fastened to the end in an analogue format, and it may be transformed using an ADC converter as part of intravenous monitoring and handling utilising the internet of things. It displays the output as whether the bottle is full , half and low and produces alarm to the nurses in duty. The alert will ring when the saline level falls below a predetermined level.



**2. Proposed System**

After it reaches the threshold level, it is first essential to replace the saline bottle. As a result, we installed an automated saline level monitoring system made up of LOAD CELL sensors, which determines the amount of IV fluid left in the container and provides a warning status if it is normal or abnormal. Secondly, we monitor and collect data like a heartbeat, the body temperature of the patient, oxygen saturation level in blood ($SPO_2$), and blood pressure. This system can automatically monitor the saline flow rate by using LOAD CELL and feeding the data to the microcontroller. Thus, the data are represented in form of Analog representation. As a result, the microcontroller outputs the processed data to LABVIEW, a buzzer, and an LCD display. With the aid of a serial port and LABVIEW, we can graphically display the results for nurses and doctors in the form of flow rate and the volume of IV fluid consumed by the patient's body. Our system consists of Auto/Manual Mode. In Auto mode, the Cayenne app will automatically manage the saline fluid flow depending on the heart sensor and temperature. With the use of IoT and similar to offline mode of operation, a nurse or doctor can change the blood flow without having to be there in person. The solenoid valve is used to controls the blood flow to dialysis machine from the human body. In our system, we have used to two solenoid level to controls the level of blood flow. Two solenoid valves in the auto mode of operation will turn ON if the patient's temperature and heart rate are both within normal ranges. Only one solenoid valve will be turned on to lower the level of saline flow into the human body in the event that the patient's heart rate or temperature are abnormal. Every data is monitored a supervised using the LabVIEW in a graphical meter format as we can able to analyse patient’s vitals for every 30 seconds and are updated on the LabVIEW screen The register space in LabVIEW's bottom section contains all the information on the victims and is formatted in code, such as L..H..SP...T...R. By using a graphical manner, any discrepancies in the measurement instruments can be quickly found. As a result, the catheter needle in the dorsum area of the patient is used to link the intravenous fluid to the patient's body. The most common site for Intravenous Catheter is the antecubital fossa usually called as forearm (the back of the hand) which has a good blood flow and most suitable comparing to the other regions. Improper insertion of IV catheter in cannula causes a swollen red tissue under the epidermal regions to that obstruct blood flow through veins and become a site of infection. So, to overcome these obstructions we designed a wrist hanging band structure which holds on the catheter region and n identifies the swell by comparing the old hand area with the updated area using LED and LDR concept.



**3. Methodology**

An intravenous fluid container is attached to the load cell, which communicates to the microcontroller through an amplified analogue signal how much load (weight) is present. Then the temperature sensor, $SPO_2$ sensor, and Heartbeat sensor are all connected. the data from these modules are collected in the form of Analog in the processing unit. The solenoid actuator is connected to the bottle and a LDR sensor placed in the wrist of the human hand for special purpose i.e., the detection of the hypodermic reactions.

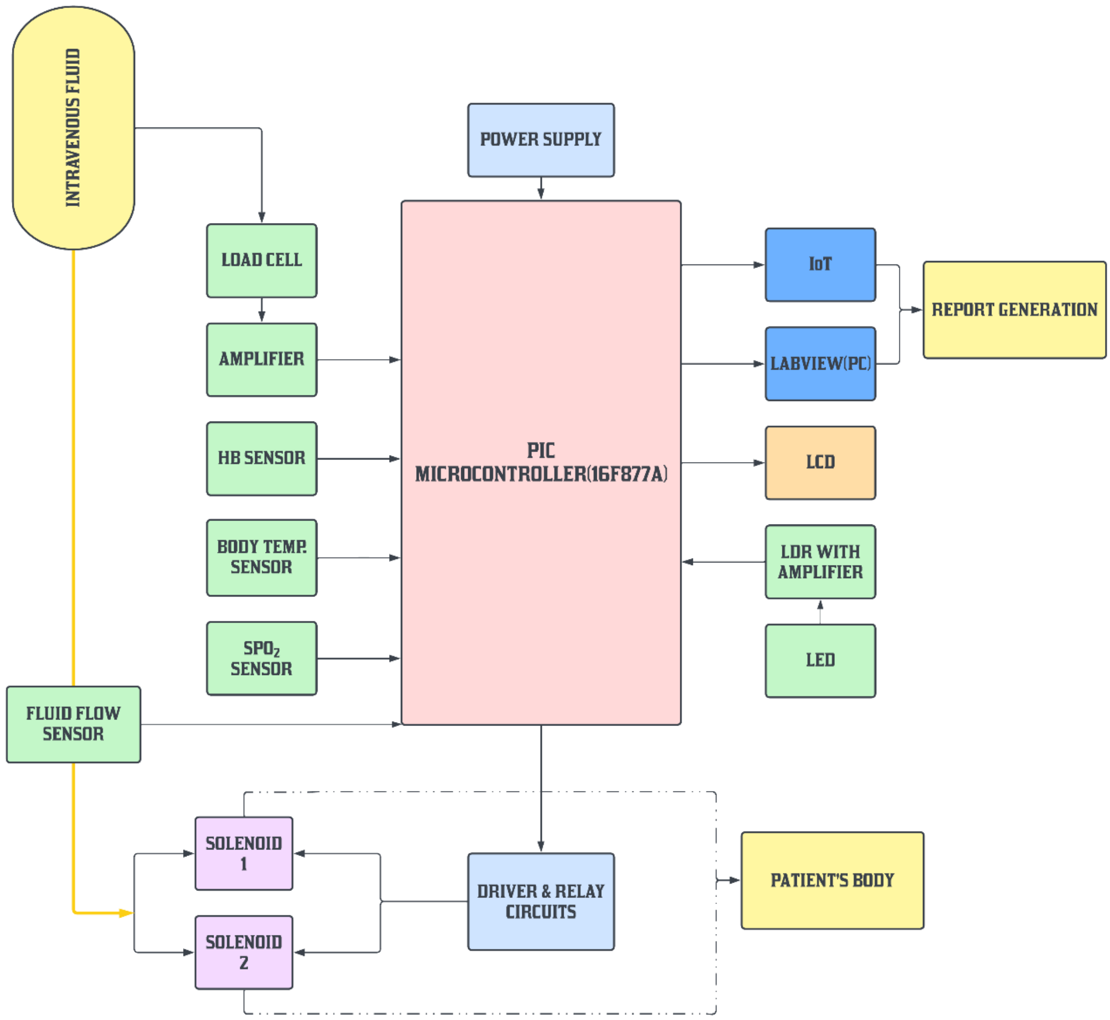


**Figure.1.** Block diagram of the project

Thus, all the data collected are processed and proceeded the output in form of digital signal to the LED, LabView software and the solenoid actuator is controlled by using The danger of unintended alterations is decreased by the IoT server that is integrated into the nurses', physicians', and carers' mobile devices.

The status intravenous fluid volume used by patients divided into three categories namely: Safe: intravenous fluid condition > 10%; Standby: the condition of the infusion liquid 5%-10% and Empty: 0% condition of intravenous fluids.

***GRAPHICAL REPRESENTATION*:** The Fig. IoT-based monitoring and handling of intravenous fluids is depicted in the outlook below.

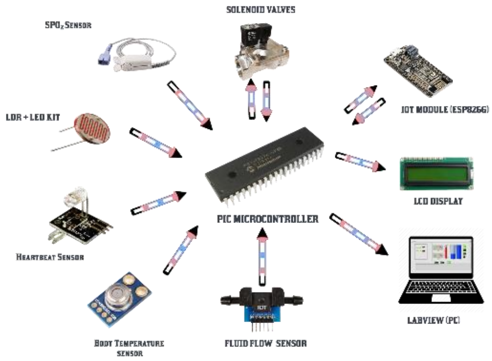


**Figure.2.** General outlook of the project

The Fig. represented next to this is the user Interface of LabVIEW software with the modules loaded on the form of blocks which is the simpler form of understanding in which Using both manual and IoT control, we are able to monitor and manage the solenoid actuator's status.


**Figure.3** User Interface of LabVIEW

Thus, all the modules created in the LabVIEW interface are programmed by using the language called 'G'. The Fig. below represents the graphical block diagram in G.

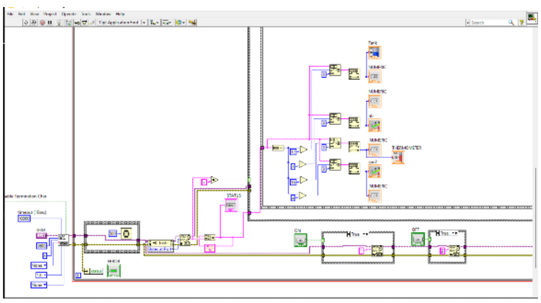

**Figure.4.** G PROGRAMMING in LabVIEW

## 4. Result and Discussion

### 4.1. IV Fluid Level

The results are based on several combinations of heartbeat, $spO_2$, body temperature, IV fluid level , fluid flow rate, and bulge detection. We can able to control the fluid flow rate using solenoid valves by using IOT.

### 4.2. LCD Output


**Figure.5.** Intravenous Fluid Full **Figure.6.** Intravenous Fluid Half Level **Figure.7.** Intravenous Fluid Low

The outputs are verified on the lcd screen placed near the patient module and the buzzer and alarm are produced warning status signal

## 5. LABVIEW Output

Thus, all the parameters were monitored and all the data are recorded inside the microcontroller and thus data are processed and output is displayed in lcd display and the output is sent to PC using USB to UART and it display graphical output in the LABVIEW software as shown below in Fig. 5.9.

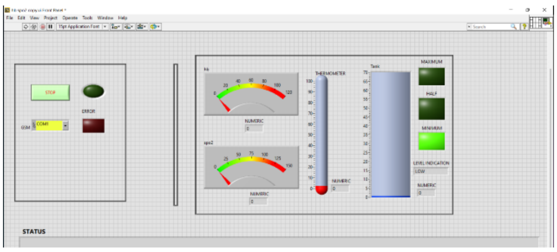

**Figure.8.** LabVIEW interface with output.

The above shown Fig.8 is the following parameters in different blocks as the data before the UART connected to the PC.

**Table.1.** SPO2 Level

| **$SPO_2$ LEVEL** | **VALUES** | **STATUS** | **MODEL** |
|---|---|---|---|
| LEVEL 1 | (SPO2<80) &&(SPO2==0) | ABNORMAL | |
| LEVEL 2 | (SPO2<80)X(SPO2>120) | NORMAL |  |
| LEVEL 3 | (SPO2>120) | ABNORMAL | |

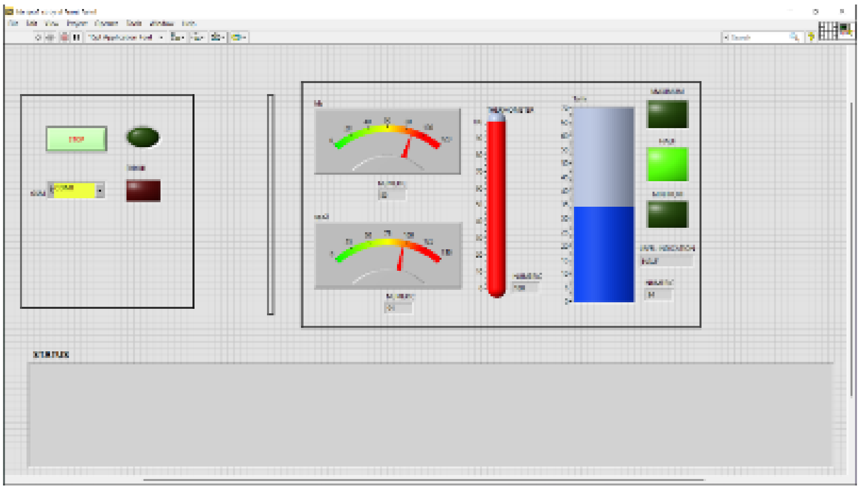

**Figure.9.** Abnormal value of heartbeat and $SPO_2$

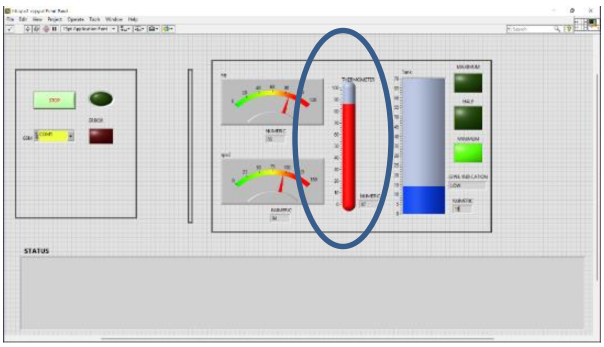

**Figure.10.** Abnormal value of temperature

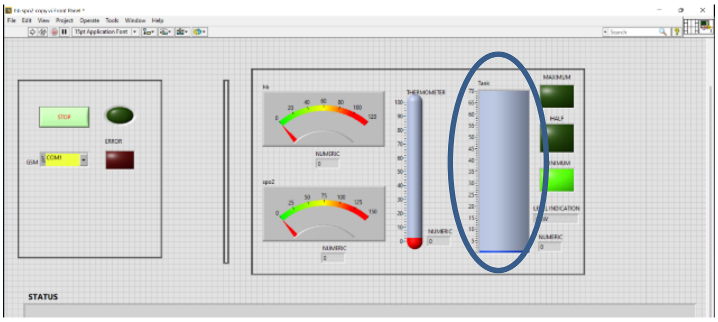

**Figure.11.** Fluid level in scale

### 6. Bulge Detection

Thus, the Intravenous Fluid is connected to the patient's body through the catheter needle in the dorsum region. The most common site for Intravenous Catheter is the antecubital fossa usually called the forearm (the back of the hand) which has a good blood flow and is most suitable compared to the other regions. Improper insertion of an IV catheter in the cannula causes a swollen red tissue under the epidermal regions to obstruct the flow of blood through veins and became a site of infection. In order to get around these obstacles, we created a wrist hanging band structure that clings onto the catheter location and detects swelling by contrasting the old hand area with the updated area using LED and LDR concepts.

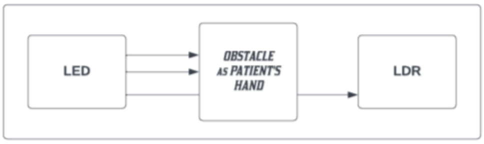


**Figure.12.** Block diagram for Bulge measurement


**Figure.13.** LabVIEW indicator for wrist

### 7. Solenoid Actuators

There are two solenoid actuators S1 and S2 are used in our project. These two solenoids are connected in parallel with the IV Administration tubes to reduce the flow of IV drugs entering the patient's body.

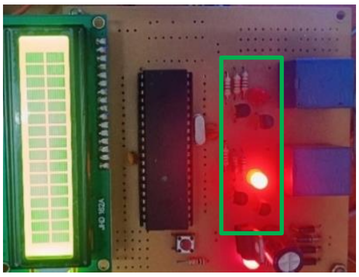

**Figure.14.** Less prior condition

**Table.5.2** Priority conditioning

| STATUS | DETECTION | ACTION TAKEN |
|---|---|---|
| LESS PRIOR | Single abnormality found. | R1 OFF / R2 ON<br>S2 only operated |
| MOST PRIOR | Two abnormalities were found.<br>Drop in IV fluid level | R1 OFF / R2 OFF<br>Both S1&S2 valves are closed |
| COMMON | No Abnormalities were found in the patient's body. | R1 ON / R2 ON<br>Both S1&S2 are operated normally. |

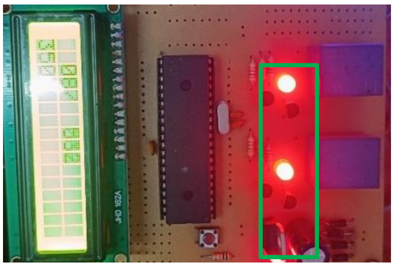

**Figure.15.** Most prior condition

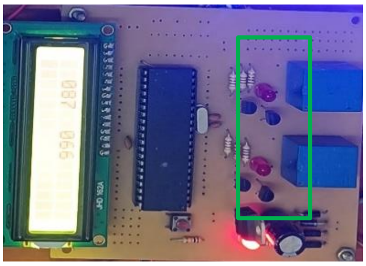

**Figure.16.** Common Condition

It is mainly used in the *hemodialysis process and ICU. It plays a vital role in Intravenous Drug therapy.*

## 8. IoT Arrangement

In the IoT module, we used the ESP8266 Wi-Fi module which was connected to the Microcontroller and the network connection of the host device. The IoT has certain parameters namely,

i. Auto mode
ii. Manual mode
iii. Temperature value
iv. SPO2 value

v. Load cell
vi. Heartbeat value
vii. LDR
viii. RELAY 1 /RELAY 2

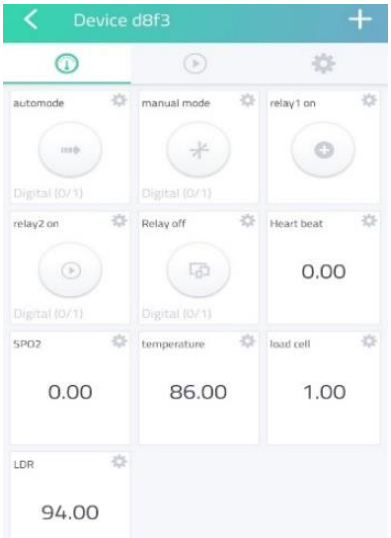


**Figure.17.** IOT Interface

The above shown Fig. are the representation of abnormalities in single parameters only. But the case is not always the same in which one or more parameters are shown at a time. The designed interface with tools for the connected device in the server operated through the host device. These stats are updated for every cycle with some delay due to network traffic

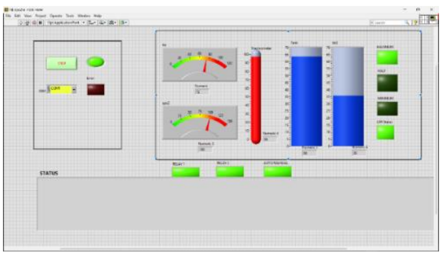

**Figure.18.** Auto mode ON

Thus, Once the auto mode is activated, the Intravenous fluid flows at the maximum rate which means that all the other parameters are at a safer level and no issues are detected in the patient's body.

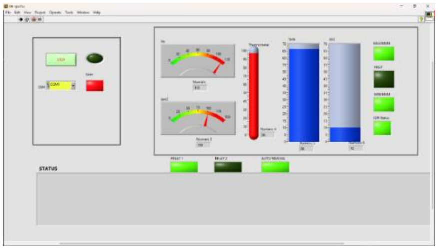



**Figure.19.** Auto mode OFF

From the above Fig. 17, both the relay R1 and R2 are turned OFF which defines that more than two abnormalities were found from the sensors.

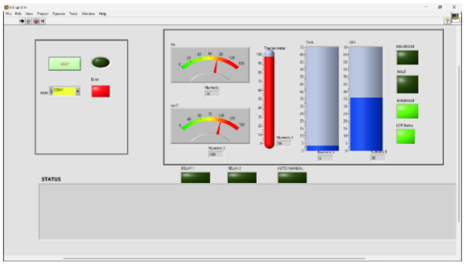

**Figure.20.** Manual mode ON

Manual mode represents that the solenoid actuators are controlled by the nurses/ doctors who take care patient's health in the real-time procedure as it was a usual day-to-day one. Fig 5.18. shows that relays 1 and 2 are controlled in a different manner and lowers the intravenous fluid flow. We can able to monitor the status of the parameters iii, iv, v, vi, and vii and control the parameters a, ii, and iii by pressing the button switch in the interface of the host device.

## 9. Fluid Flow Sensor

The fluid flow sensor measures the amount of IV fluid that passes through the sensor per minute. It is normally measured in the range of ml/min. For an average adult, the flow rate would be 2mg/min. The flow data will be updated in the microcontroller which stores the data as a stack counter and monitors it. If abnormalities are found in the patient's body the Solenoid valve got activated which reduces the flow can also be monitored in the LabVIEW and the flow will also be stopped if the parameters are found abnormal.



**Table. 5.3** Flow rate reduction

| FLUID FLOW | DETECTION | ACTION TAKEN |
|---|---|---|
| 2 ml | Single abnormality found. | R1 OFF / R2 ON<br>S2 only operated |
| 1 ml | Two abnormalities were found.<br>Drop in IV fluid level | R1 OFF / R2 OFF<br>Both S1&S2 valves are closed |
| 0 ml | No Abnormalities were found in the patient’s body. | R1 ON / R2 ON<br>Both S1&S2 are operated normally. |

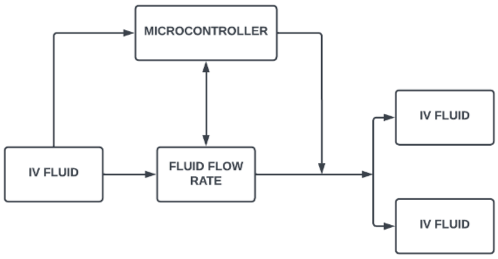


**Figure. 5.21.** Block of fluid flow

**10. Conclusion**

At last, from measuring all the data of patients through the sensors, we can now come to a conclusion that it is necessary to establish our project during the Intravenous Drug Administration to maintain a report of the patient about their body where we can able to point out the spike of any vitals during supervising using the data obtained from the National Instruments LabVIEW software. There is no compulsion for a doctor to be in real-time to monitor the patient as we included the IoT module. we can find any information and can control the drug flow rate through solenoid actuators which are really useful in efficient precise level flow in ml/sec. Additionally, we used a wristband style LDR coupled to an LED to identify the bulge in the area where the IV was injected by contrasting it with the usual hand. hand using light dependent source. From this, it can be useful for any type of hand it may be thin, thick even neonates can also been taken care by our system. This system is a mandatory blood leak detector (BLD) in a haemodialysis machine and is it is a lifesaving system. The healthcare technician takes immediate and appropriate action and prevents the patient from any major problem during *blood leakage in haemodialysis*. Well, it can be remotely operated reducing manual and manpower as well as Time-saving system. So, that it can Avoid accidents occurred during intravenous therapy and carelessness.



## 11. Future Scope

This system is an efficiently economical project, but the only region where it needs Some more updating thing is the size. The size can be reduced by changing the power supply of the circuit from AC supply to DC supply by placing Lithium-ion batteries instead of transformers. Thus, using lithium-ion batteries increases the life span of the device by increasing its safety in it. When this project is designed as a device, then the cost of the components and the material used can also be reduced. Before making it as a product, we should analyze all the failure occurring during the operation of the product apart from failure a certain code should be given along with it. So, it makes this project an easily available product on the market. If any issues arise in the product, then it should be serviced through the installed controller by activating several commands in it.

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