Intravenous Therapy Supervising And Handling Using IoT

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Abstract*: An automatic Intravenous Fluid Administration and handling using IoT saline level monitoring consists of Load cell sensors which are used to measure the level of Intravenous fluid in the container whether it is Full or Low with warning status. The detection of the load is in Analog format. The output obtained from the sensor is displayed in the LCD display. When the level of saline goes below a threshold level, the alarm sound will be produced. Thus, the flow rate can also be controlled by the doctor using IoT as well as automatically with the help of input sensors placed for patients and displayed graphically in LabVIEW software.*

KEYWORD: IoT, Solenoid Actuators, Heartbeat sensor, LabVIEW

I. INTRODUCTION

Modern problems always require modern solutions A Lifesaving system. This paper proposes a proof-of-concept system that uses no pain, level sensing with a lesser power-consuming computing platform to deliver continuous infiltration monitoring around the IV catheter site. 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 designed in order to help the nurses and caretakers as it is considered as automation application. 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 as to analyse the presence of any underlying diseases may affect the patients during the infusion process like respiratory issues, anaemia, feel nausea over time. 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 for a large number of patients in the absence or a smaller number of nurses to patient ratio. The LabVIEW is very helpful for people with less technical knowledge So, This project can be easily acknowledged by everyone around the globe without any barrier to the communication

Due to the increase in the population, there is a need for improvement in health care. 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 main objective of system is to provide authentic, accessible, easy and economic system for saline level monitoring. The saline is inserted into blood by considering certain characteristics like heart rate, blood pressure, body temperature, pulse rate and body weight of patient. 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. Thus, it was placed in rural villages and remotely villages can have this system to cope up the upcoming issues. Initially, this might be inferred as an event. But the consequences are harmful. When the IV bottle Thus, 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. By means of this the nurses can supervise the amount of IV fluid remains even from the control room. The Intravenous supervising and handling using IoT consists of load weighs the bottle fixed to the end in an Analog format and it can be converted using ADC converter. It displays the output as whether the bottle is full , half and low and produces alarm to the nurses in duty. When the level of saline goes below a threshold level, the alarm sound will be produced.

II. PROPOSED SYSTEM

At first, it is necessary to change the saline bottle after it reaches the threshold level. So, we connected an automatic saline level monitoring consists of LOAD CELL sensors which are used to determine amount of IV fluid remains in the container whether it is normal or abnormal with warning status. Secondly, we monitor and collect data like heartbeat, body temperature of the patient, oxygen saturation level in blood (SPO_2), blood pressure. This system can automatically monitor the saline flow rate by using LOAD CELL and fed the data to microcontroller. Thus, the data are represented in form of Analog representation. Thus, the processed data from the microcontroller is transferred as output to LABVIEW, buzzer, LCD display Using LABVIEW, we can visualize the data to nurses or doctors and display the results in the form of flow rate, amount of IV Fluid in taken by the patient's body in Analog units with the help of serial port in graphical format. Our system consists of Auto/Manual Mode. In Auto mode, the saline fluid flow will be controlled based on heart sensor & temperature automatically and it's monitored in the cayenne app. Nurse/Doctor can vary the blood flow without the need to presence in person with the help of IoT as like as in offline mode of operation. The solenoid valve is used to controls the blood flow to dialysis machine from human body. In our system, we have used to two solenoid level to controls the level of blood flow. If patient heart beat and temperature values are normal, two solenoid valves will be turned ON in the auto mode of operation. In case of patient heart rate or temperature is abnormal, the only one solenoid valve will be ON to reduce the saline flow level into human body. 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 in the LabVIEW display All the data about the victims are mentioned in the register space located in the bottom area of the LabVIEW in a Code format (e.g., L..H..SP…T…R.) Any Discrepancies in the measuring instruments can be easily identified by graphical method 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 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 obstruct the flow of blood through veins and became a site of infection. So, to overcome these obstructions we designed a wrist hanging band structure which holds on the catheter region identifies the swell by comparing the old hand area with the updated area using LED and LDR concept.

III. METHODOLOGY

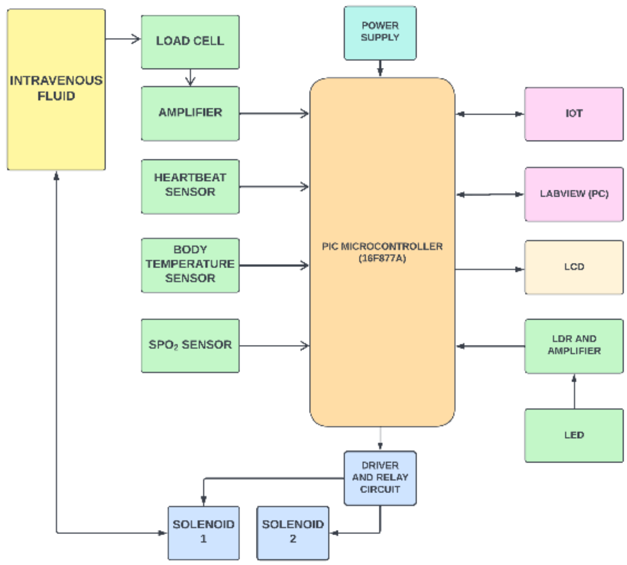


Fig. 5.1 Block diagram of the project

Intravenous Fluid Container is connected to the load cell which sends an amplified Analog signal about the amount present in terms of load(weight) to the microcontroller. 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 and the solenoid actuator is connected to the bottle and a LDR sensor in placed in the wrist of the human hand for special purpose i.e., the detection of the hypodermic reactions.

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 IoT server in the handy devices of the nurses, doctors and can be seen by the caretakers also reduces the risk of undesired changes.

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.

IV. GRAPHICAL REPRESENTATION

The Fig. represented below shows the outlook of the working of Intravenous Fluid supervising and Handling by using IoT.

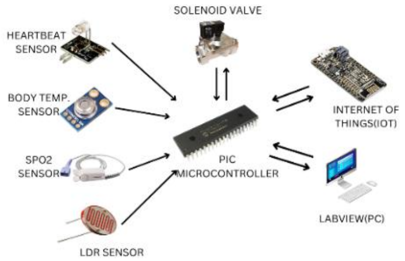


Fig. 5.2 General outlook of the project

The Fig. represented next to this is the user Interface of LabVIEW software with the modules loaded on form of blocks which is the simpler form of understanding in which we can able to supervise and handle the status and the solenoid actuator using IoT control as well as the Manual control.

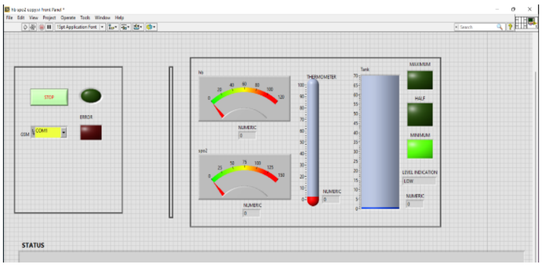


Fig. 5.3 User Interface of LabVIEW

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.

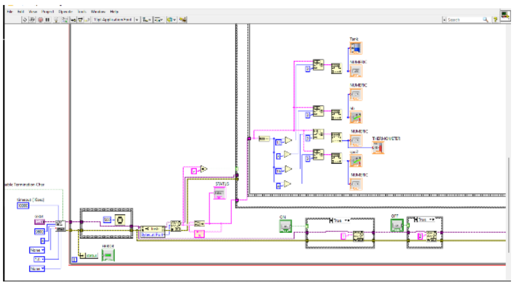


Fig. 5.4 G PROGRAMMING in LabVIEW

V. RESULT AND DISCUSSION

IV FLUID LEVEL

The results are based on the several combinations of heartbeat, spO_2, body temperature, IV fluid level

LCD OUTPUT

Fig. 5.5 Intravenous Fluid Full

Fig. 5.6 Intravenous Fluid Half Level

Fig. 5.7 Intravenous Fluid Low Level

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

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.

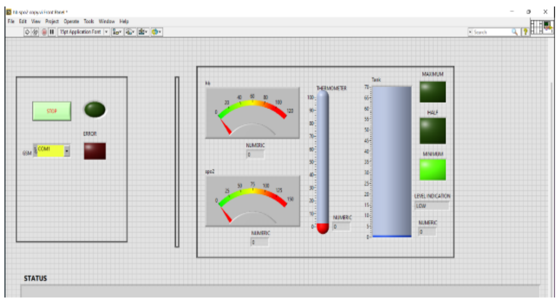


Fig. 5.8 LabVIEW interface with output.

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

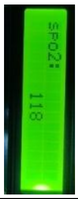
SPO_2 LEVEL	VALUES	STATUS	MODEL
LEVEL 1	(SPO2<80) &&(SPO2==0)	ABNORMAL	
LEVEL 2	(SPO2<80)X(SPO2>120)	NORMAL	
LEVEL 3	(SPO2>120)	ABNORMAL	

Fig. 5.9 Abnormal value of heartbeat and SPO_2

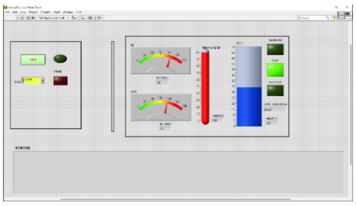


Fig. 5.10 Abnormal value of temperature

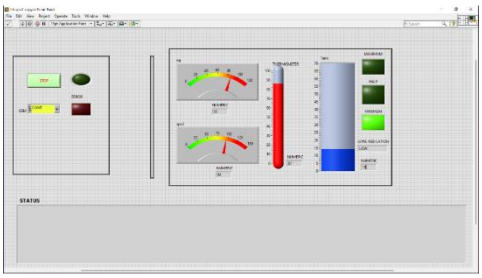


Fig. 5.11 Fluid level in scale

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.

So, to overcome these obstructions we designed a wrist hanging band structure that holds on the catheter region and identifies the swell by comparing the old hand area with the updated area using LED and LDR concepts.

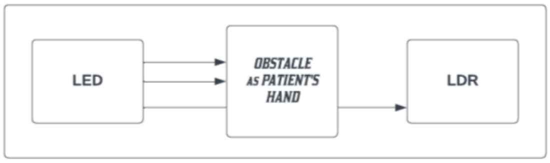


Fig. 5.12 Block diagram for Bulge measurement

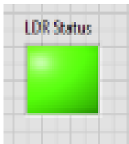


Fig. 5.13 LabVIEW indicator for wrist

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.

Table 5.2 Priority conditioning

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

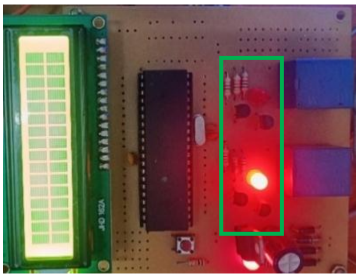


Fig. 5.14 Less prior condition

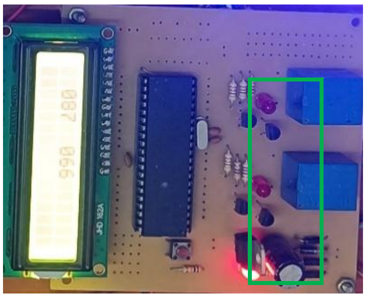


Fig. 5.15 Most prior condition

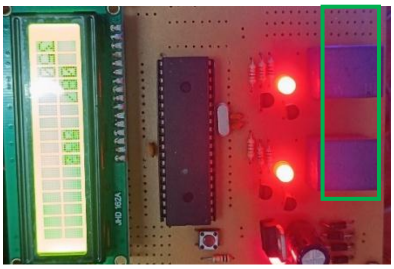


Fig. 5.16 Common Condition

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

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

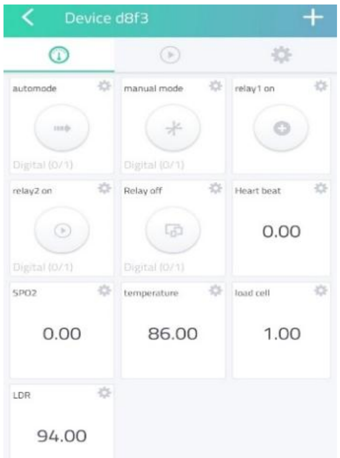


Fig. 5.17 IOT Interface

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

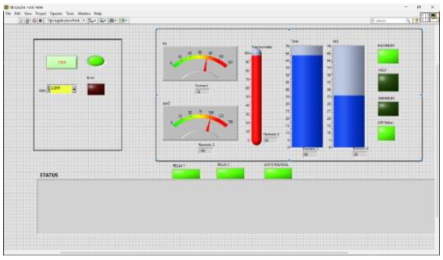


Fig. 5.18 Auto mode ON

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.

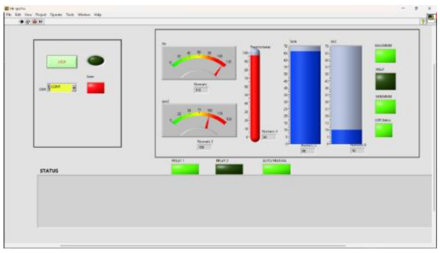


Fig. 5.19 Auto mode OFF

From the above Fig 5.17, both the relay R1 and R2 are turned OFF which defines that more than two abnormalities were found from the sensors.

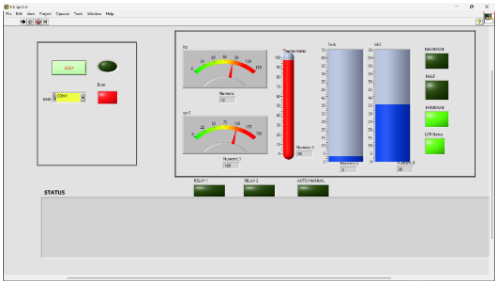


Fig. 5.20 Manual mode ON

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 represents that relay 1 and relay 2 are operated in alternate condition and reduces the flow of Intravenous Fluid.

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.

VI. 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. We also included a wrist band type LDR connected with LED to detect the bulge in the region the of IV injected by comparing the normal hand and the bulge hand using light dependent source. From this, it can be useful for any type of hand it may be thin, thick even neonates are taken care of 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

VII. 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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