An Innovative Approach to Control and MonitorI.V(Intravenous)Fluids

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Abstract—***Traditionally, doctors and nurses estimate the time, which takes for an IV bottle to empty based on their expertise, making I.V (Intravenous) therapy prone to misstep. The presentanalysis suggests acyber spaceenabled I.V drip chamber monitoring platform. The technology permits medico and healthcareassistance to remotely auditordrip criterion,interim focusing on economical and great responsibility. In this work, a capacitive sensor is acclimated to determine the flow of liquefied in the bottle and the servo motor to give live update and management of the fluid flow through the device. Moreover, the projected system can have the scope of a programmer employing an input device and wi-fi permitting the para medical staff to provide new commands. Ultimately it facilitates the work of doctors, nurses, and alternative associated personnel or any para medical staff. The purpose of this work is to design an I.V (Intravenous) with the ability to immediately stop the flow of an I.V (Intravenous) and send a notification to the nurses and physicians, reducing the labor of nurses and doctors which also helps to prevent I.V related fatalities.***

Keywords—:*I.V (Intravenous) therapy, I.V bottle, Capacitive sensor, Para medical staff.*

I. INTRODUCTION

I.V Drip Set is used to deliver nutrients and hydration directly into the bloodstream for immediate absorption and use by the body. Intravenous Therapy is the quickest way to get nutrients into the body because it bypasses the digestive system and goes straight to the organs, resulting in absorption rates of 90 to100 percent. Administering I.V lines is a regular action for any health care assistant in almost every hospital (Nurse). The necessity for fluid and electrolyte assessment and management is the most basic requirement. In the hospital, the I.V-line monitoring is done entirely by nursing assistants. The I.V bottle level is monitored by the health care assistant. Unfortunately, the observer may forget to change the bottle at the appropriate time due to their busy schedule. Simple IV bottles with no further indication are used in the hospital. Any form of failure can cause different medical problems such as blood backflow in I.V setup. In certain situations, if the bottle gets empty and has not been checked for a certain duration, the air bubble may also be placed in the IV tube, which can be fatally monitored and thus vital. To prevent this, the current technique will facilitate the work of doctors, nurses, and alternative associated personnel or any para medical staff. The purpose of this work is to design an I.V with the ability to immediately stop the flow of an I.V and send a notification to the nurses and physicians, reducing the labour of nurses and doctors which also helps to prevent I.V-related fatalities.

Main scope of work is to design an IV Stand which informs the health care assistant. Keep an eye on the IV line to signal the assistant that he has to come in right away.

Fig1: Blood back flow

Fig2: Air bubble

II. RELATED WORK

A light sensor-based device is proposed by Raghavendra B etal., In [2016]. Reduction in complications associated with IV drip system was achieved with such a device, particularly in resource limited settings. Reliant on the shape of container was problematic to replicate drip rate outcomes.

In [2017] Ramisha Rani K etal., proposed" Smart Drip Infusion Monitoring System for Instant Alert". They developed an effective system capable of monitoring the point of the IV drip administered to the patients in the clinic and evidence for the same. This recorded info can be analysed in the medico station remotely for later reference. The recorded reports can be presented adequately with accurate info in a graphical way. Consumption of energy was more due to graphical representation, was expensive, not all hospitals could afford.

Keerthana K etal., "A Survey of Systems used in the Monitoring and Control of Intravenous Infusion". They developed a system to classify the process of intravenous infusion regulation and monitoring with the help of infrared detection sensor. They aim at regulating the rate of infusion and sending an alert in case of events like drastic change in flow rate nil flow or blockage of the tube. Display consumes high power (due to IR sensor were attached to the drip chamber).

In [2019] Sincy Joseph etal., proposed "Intravenous Drip Monitoring System for Smart Hospital Using IoT".They implemented an I.V drip surveillance entity to diminish the work of medical management. The main features of this system are installation of hardware as well as software sensors, fletching and storing details in an electronic information service. Rectification of gathered details to imbrute the drip reviewentity was tedious.

In [2020] Mahak Goyal etal., "I.V (Intravenous)tube flow control device with IOT" They used Capacitive sensor to function whether there is solutionuseablein the packet or not, in case that detected air in the ampul, later the testimonyisdirected to NodeMCU. Theindication of this task is to flourish an IV with potentiality so the discharge of an IV can spontaneouslyblock and analert will be emitted to

paramedical workers which also help to reduce the casualties related to IV. No proper alarms were generated due to network connectivity.

In [2020] Sanjay S etal., "Iot Based Saline Infusion Monitoring and Control System." They proposed a framework for IoT Based Saline Infusion Monitoring and Control System that makes use of Arduino and Node mcu. The theory is used to informant the saline elevation, such that, it automatically stops the saline flow to the patient when the saline level reaches 20% of its total volume. Was working only for saline solutions but not for other solutions.

In [2021] M. Safitrietal., "Short Text Message Based Infusion Fluid Level Monitoring System" The entity was depiction to control the fluid infusion points by absorbing a short text message system. Which will provide disclosure when the infusion point is at 50 ml, 20 ml, and 0 via SMS by using SIM Modem 900. Infra-red sensors and photodiodes are worn to encounter intravenous droplets of fluid, which calculates fluids' volume. Based on the analysis, infusion solution flow monitoring systems had the rate of program failure when detecting aqueousimpart was just 1,21%.

In [2021] P. Sardana etal., "Design, fabrication, and testing of an internet connected intravenous drip monitoring device" The present study proposes aweb connected exanimating for IV drip chambers. It has two majorparts, specifically chamber part and pole part for level disclosure. The organized info was solidly and assuredly accrued to virtual service adopting HTTP API calls (Hyper Text Transfer Protocol). This input was mended and envisioned for ease of legibility for healthcare takers. There was a lag while transferring the message to concern paramedical staff due to traffic issue or noise distortion.

III. CLINICAL SURVEY OBSERVATION

Clinical studies were carried out through visits to a variety of healthcare centres and a detailed survey through a systematically designed questionnaire for the healthcare providers. Based on the data collected through the survey, the following observations were made. • A positive response was received when asked if the stopping of drip as soon as the drip bottle gets empty as necessary. • Paramedical staff members agreed that the occurrence of blood backflow is very often when the drip bottle empties and the flow is not stopped. • Doctors and nurses agreed to the fact that a simple device that can monitor and control IV drip administration would make their jobs easier.

IV. PROBLEM STATEMENT

The fundamental issue with IVs is that a nurse would be Refilling or modifying the IV. Generally, this operation is extremely exhausting and time-consuming and requires the full participation of nurses during the day of the hospice where there are just one or two nurses for every ten to fifteen patients. Even if we are using a heavy

machinery-built IV indicator, this is very expensive for starters and does not fix the problem of notifying the patient that he/she needs to change the IV on time.

V. OBJECTIVE

IOT-based automatedmodifying and determining the tool is designed where sensor's utilized. When the Fluid level is empty, it will alert the observer by sending a notification to mobile.

The work will be focused on achieving these objectives:

1. To develop a case to indicate the liquid surface level of IV fluid and alert the heath care assistant for timely intervention.
2. To send the alert message when the fluid rate is FULL, HALF, EMPTY, as the device count the flow of the solution and monitor infusion flow rate.
3. To design the device, compact with the existing IV stand by using IFTTT application, as the monitoring can be done by the medical staff staying away from the patient site where Wi-fi is enabled, as an application-based alert intimation for the health care assistant.
4. To add keypad buttons and Help button for manually controlling and monitoring infusion rate flow by any para medical staff.

VI. SYSTEM ARCHITECTURE

Major things in the proposed system are Esp32- Microcontroller, 2 conductive electrode strips. We have Esp-32 Microcontroller, which has been used and it is programmed according to the requirement and is used to assign the notification on streamed and Blynk application is used to post alertsallied to IV to medical causalities.

• The Capacitive sensor has been connected to the I.V packet which conveys the packet is empty or not. As the fluid gets vacant, the parallel plate sensor is linkedto Esp-32 microcontroller that regulates the position of saline liquid.

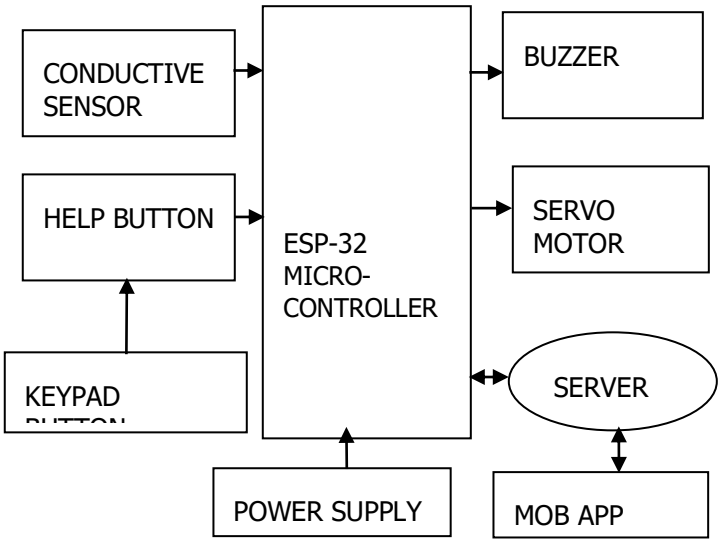
• As the discharge has been blocked the stature of position of the fluid will be sent to a blynkserver. Esp-32 microcontroller has Wi-Fi competence that willcirculate this notification on the internet.

• For control the infusion flow wirelessly we can do it by using servo motor with the help of IFTTT application, which helps in recognizing the voice and perform actions for controlling and monitoring the flow of I.V solution.

• To control the infusion rate flow manually we are making use of key buttons, which help to control the I.V solution in the bottle.

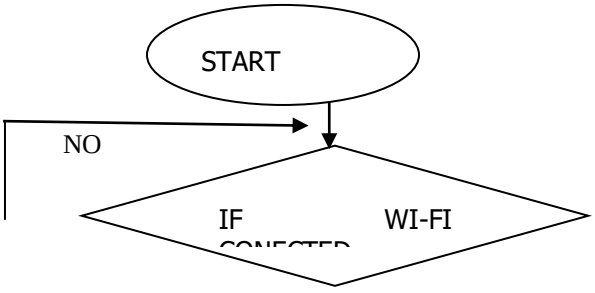
• In the case of any emergency, patient concern person can use help button, which helps doctor or para medical staff to intimate the issue and rectify it with help of buzzer and help notification.

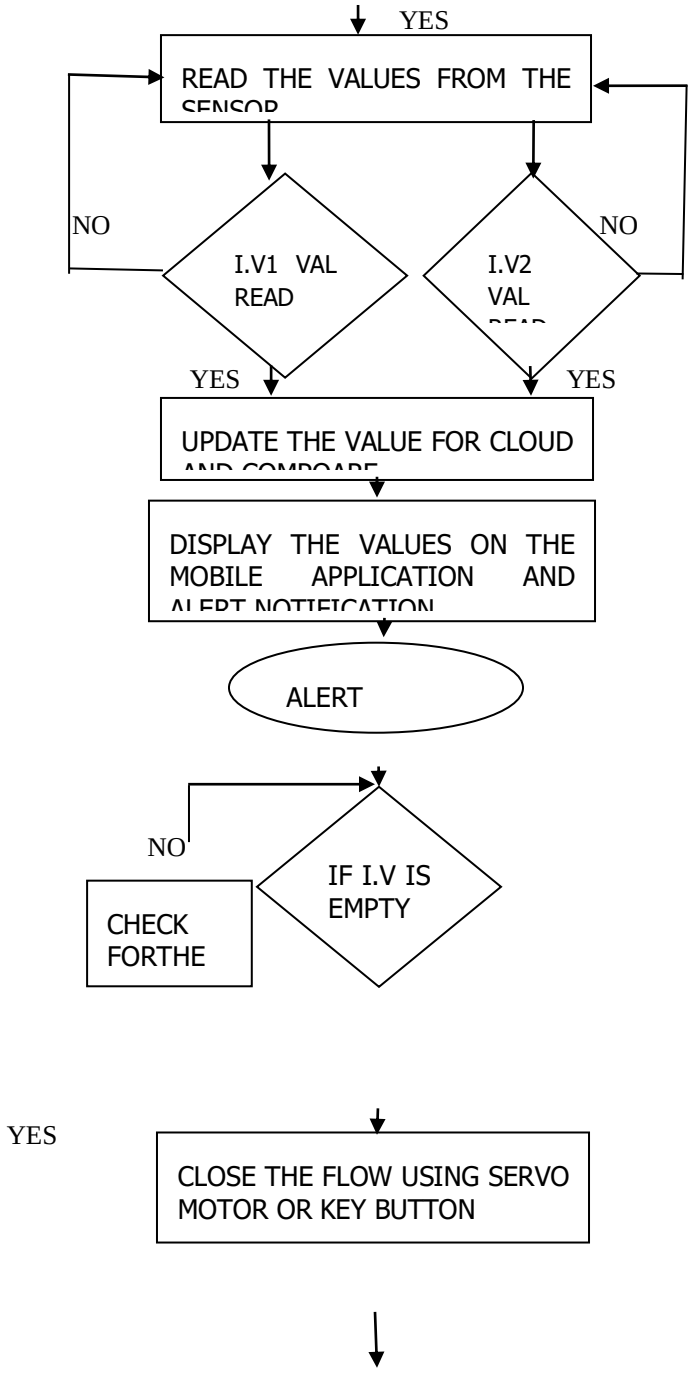
• Blynk application can be acquired by respected paramedical workers which will be a vast avail to medical healthcare takers as they have the expertise of the I.V saline solution level.

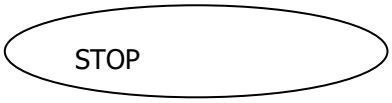


VII. PROPOSED SYSTEM

In this work a regulating and monitoring device that might be retrofitted to an existing I.V. infusion system. I.V. (Intravenous) therapy is prone to human error since doctors and nurses estimate the countdown whichcaptures for an I.V packet to vacant depending on their expertise. A capacitive sensor is enforced in this work to determine flow of a fluid in a bottle, and a servo motor is used to provide real-time updates and management of the fluid flow through the device. Finally, it aids the work of doctors, nurses, and other ancillary professionals, as well as any paramedical personnel. The goal of this project is to create an intravenous (I.V) with the ability to promptly stop the flow of an I.V and send a notification to nurses and doctors, decreasing nurse and doctor workload while also lowering IV-related mortality.




YES
READ THE VALUES FROM THE SENSOR
NO
I.V1 VAL READ
I.V2 VAL
NO
YES
YES
UPDATE THE VALUE FOR CLOUD
DISPLAY THE VALUES ON THE MOBILE APPLICATION AND
ALERT
NO
IF I.V IS EMPTY
CHECK FORTHE
YES
CLOSE THE FLOW USING SERVO MOTOR OR KEY BUTTON



VIII. SYSTEM REQUIREMENT

- Software requirement
  - Arduino ide
  - Blynk
  - Ifttt

- Hardware requirement
  - ESP32
  - Conductive sensor
  - Servo motor
  - Buttons
  - Jumper’s
  - Bread board
  - Power supply

IX. METHODOLOGY

- Major things in the project are Esp32- Microcontroller, 2 conductive electrode strip, servo motor.we have Esp-32 Microcontroller, which has been used and it is programmed according to the requirement.
- To carry out this demonstration, we willinitiate this apparatus as follows: First and foremost -, our driver circuit with conductive electrode strip, isprimarily acts as a parallel plate capacitor which changes its output voltage with the change of its dielectric medium in between its plates, which senses the amount of saline solution in the I.V packet.
- The corelate plate has been associated on the I.V packetwhich tell us if the solution is empty or not. As it gets vacant,the capacitive parallel levelsensor is linked to the Esp-32 microcontroller which controls the position of liquid. Once the liquid flow has been stopped, the condition of the saline fluid will be emitted to a server. Esp-32 microcontroller has WI-FI potential used to circulate this notification on stream.
- Blynk application can be penetrated by esteemed medical staffs which tends to be great help to nurses as they have the understanding of the saline level.
- As the fluid level decreases nurse will get an intimation i.e., notification indicating as empty.
- To control the infusion flow they will be having two options: Firstly, voice command can be given from elsewhere using IFTTT by following commands,

- TURN OFF - Where turn off condition is used for turning off the infusion flow.
- TURN MIDDLE - Where turn middle condition is used for turning middle the infusion flow.
- TURN FULL - Where turn middle condition is used for turning fully with respect to infusion flow.
- By using above conditions over a voice, we will be able to control the infusion flow. To function above conditions wirelessly, I have used new technology for voice over controlling the functions i.e., IFTTT (if then than that). where the voice is controlled by google assistant and based on voice command the servo motor functions whenever any paramedical staff is away from the patient site.
- We are using Servo motor, has integrated gears and a shaft that can be specifically composed. It let on the shaft to be positioned at discreate angles, by taking these angles we have 3 conditions:
- Full – is used for raising the infusion flow when angle is at 180 degrees.
- Half – is used for quite slowing down infusion flow when angle is at 90 degrees.
- Close – completely closing the infusion flow when angle is at 0 degree.
- The above conditions work wirelessly by using IFTTT and based on voice command, the servo motor allows the rotation of the shaft. Which further helps in monitoring the infusion flow when nurse or any paramedical is away from the patient site.
- By this work, will be an enhancement in the extant I.V infusion packet as this will have network connectivity and control aspects.
- This way the whole mechanism will be embraced for the apt functioning of the I.V system.

X. RESULT

- Result 1: when fluid is full inbottle

If sm1val is 0 and sm2val is 0 then it will detect the water or any saline solution in the packet and willresult it too full.

When it is full then led 1 gets on. So, in this device, I have given led1 as green colour whichindicates that the solution inthe packetisfull.

In bylnk application, on V7 led, itwillbe writingdown theI.V. stateasFULL, based on the quantity of the solution.

- Result 2: when fluid is half in bottle

If sm1val is 1 and sm2val is 0 then it will detect the water or any saline solution in the packet andwill result it to half.

When it is half then led 2 gets on. So,in this device, I have given led2 as yellow colourwhich indicates that the solution in the packet is half.

In bylnk application, on V7, it will be writing down the I.V. state asHALF, based on the quantity of the solution.

- Result 3: When fluid is empty in bottle

If sm1val is 1 and sm2val is 1 then it will detect the water or any saline solution in the packet and willresultittoempty.Whenitisemptythenled3getson.So, in this device, Ihavegivenled3asredcolourwhich indicates that the solution in the packet is empty.

In bylnk application, on V7, it will be writing down the I.V.stateas EMPTY, basedon the quantity of the solution.

Since the I.V state is empty. It will be sending the

notification to any para medical staff, until they

removeor update the injectedI.V.

- IFTTT command creation

The below details, indicates the creation of 3 commands in IFTTT application using google assistant and webhooks.

TURN FULL – if we say TURN FULL over a voice then it gives a web request for turning the infusion flow in full state.

TURN MIDDLE – if we say TURN MIDDLE over a voice then it gives a web request for turning the infusion flow in middle state.

TURN OFF – if we say TURN OFF over a voice then it gives a web request for turning the infusion flow in off state.

- Result 4: IFTTT turn off command

Below description says how do we create a simple phrase for voice command for TURN OFF and how does it function back to the voice over command from the website using authentication token and with the servo motor angle at 0 degree.

when the voice command TURN OFF is given to google assistant, the flow of the infusion rate will be in normal flow. The servo motor will be at 0 degree which indicates the nob is in off state.

- Result 5: IFTTT turn middle command

This result express how do we create a simple phrase for voice command for TURN MIDDLE and how does it function back to the voice over command from

the website using authentication token and with the servo motor angle at 90 degrees.

when the voice command TURN MIDDLE is given to google assistant, the flow of the infusion rate will be slightly higher than the normal flow. The servo motor will be at 90 degrees which indicates the nob is in middle state.

- Result 6: IFTTT turn full command

This result defines, how do we create a simple phrase for voice command for TURN FULL and how does it function back to the voice over command from the website using authentication token and with the servo motor angle at 180 degrees.

when the voice command TURN FULL is given to google assistant, the flow of the infusion rate will be fully higher than the normal flow. The servo motor will be at 180 degrees which indicates the nob is in full state.

- Result 7: Manually controlling the flow of I.V solution using key buttons

There are 3 buttons which helps in controlling the flow of I.V,

1. 1st button: by pressing this button it helps in increasing the infusion flow rate of I.V solution.
2. 2nd button: by pressing this button we can moderately control the infusion flow rate of I.V.
3. 3rd button: by pressing this button we can stop the infusion flow of I.V solution.

- Result 8: Help button

Help button is used in case of any emergency. The patient can press this button, once they press the help button- buzzer gets on if any paramedical staff is near then they can come and rectify the issue.Apart from this, will be initiating help notification on Blynk application which will be further intimated by any paramedical staff.

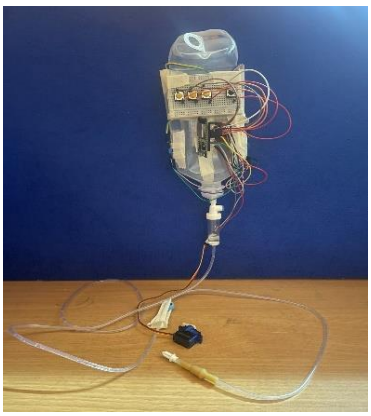


Fig 3: Model Setup

The above Figure is the representation of the complete model Setup with ESP32, Servo Motor, Conductive Sensor, and Help Button.

XI. CONCULSION

In our proposed system, we will be designing and implementing an automatic intravenousfluid control device. Thisdevicewilladvancethepatientcareandmakeittrouble-free. Our proposed system will be a perfect helping hand in case of controlling intravenous fluid for theclinical aspects as it has ability to immediately stop the flow of an I.V (Intravenous) and send anotificationtothenursesandphysicians,reducingthelabourofnursesanddoctorswhich alsohelps to preventIV-related fatalities.

XII. FUTURE SCOPE

- We need to design and manufacture the dedicated flow control knob for the infusion of I.V.
- We can further add patient monitoring system to the same which monitors the parameters such as heartbeat, SPO2 value, Temperature etc.
- we can develop our customized Android Application for the same.

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