Intravenous Fluid Level Indicator

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Abstract - *With the increased growth of the population, health care plays a vital role in leading a contented life. In hospitals, ensuring the patients' safety is the most important thing. Hence automatic health monitoring systems are the most sought after because it gives precise information while reducing the stress of the medical practitioners and the bystanders of the patient about missing certain critical data. Also, indicating when the intravenous fluid administered to the patient falls below a critical level is a tedious process and a tougher job. Monitoring the level of intravenous fluid level manually is a simpler job but if not done with utmost care may affect the health of the patient severely. This may lead to blood loss or backflow of blood to IV tube from their veins. If the bottle gets fully drained, air enters the tube and in turn into the vein, which may prove disastrous to the patient. So automating this system might prove really helpful. A system is designed such that if the Intravenous fluid reaches a critical level, it is sensed by the LED and LDR set up and an alarm is sounded at the nurses' room indicating the room number. When this is done, the nurse can easily identify the room and go there directly to change the bottle rather than keep checking every room to notice if the fluid has reached the critical level. This requires the use of RF transmitters and receivers to transmit to distances.*

***Key Words*: Arduino Controller, Buzzer, Intravenous fluid, LDR, LED, RF Transmitter, RF receiver.**

1. INTRODUCTION

Generally, intravenous therapy is a medical procedure in which the liquid substances (medications) are directly inserted into the vein through an IV tube and a needle is inserted into the patients' vein. A sealed device called drip chamber controls the entire process so that the substance slowly pass into the vein, and it also blocks the air to enter into the bloodstream. An IV drip is usually used for long-term treatments. But it can also be used for short-term treatment to rehydrate patients or to give them medicines to revitalize them. It is a very efficient process for quickly supplying the prescribed medicines into the entire body. The intravenous therapy is not only used to correct electrolyte imbalances but it can also be used to deliver medicines. Patients those who cannot consume enough nutrients or who cannot eat at all due to an illness, surgery or accident, can be fed with enough nutrition through their vein using IV therapy. These sterile solutions (sodium and dextrose) containing necessary nutrients to support human life is injected into the patient's body through a tube attached to the needle. Due to the lack of care, many problems will arise such as blood loss, backflow of blood through an IV tube. To overcome this situation an effective idea is proposed to develop an effective health monitoring system which alerts the doctor or nurse when the fluid level of the saline bottle is below the threshold limit.

2. NEED ANALYSIS

2.1 Bull Diagram

Intravenous fluid level indicators are very much essential to assist medical practitioners to take proper care and the patients' health. Our project aims to fulfill the same by monitoring the level of IV fluid and alert the medical practitioner whenever the level goes below a critical value thus aiding in the removal of IV medication once it gets over and hence preventing the backflow of blood.

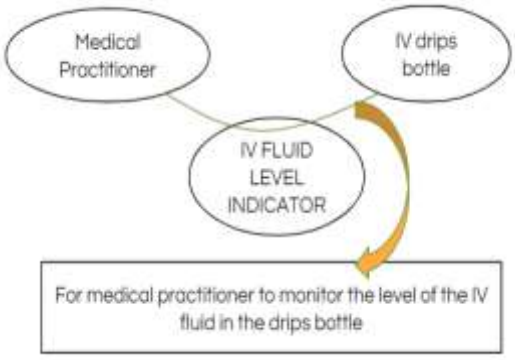

Fig - 1: Bull Diagram

3. FUNCTIONAL ANALYSIS

3.1 Octopus Diagram

The octopus diagram represents the service functions. The product to design is in the center of the diagram., and the external elements (EE) of the environment are positioned around. The primary function links to external elements through the product. The constraint function links directly an external element to the product. It is a characteristic, an effect or an arrangement of design that is mandatory or that has been forbidden for any reason.

For our project the primary functions are

- To measure the level of the IV fluid in the drips bottle.
- To indicate the level of fluid to the medical practitioners.

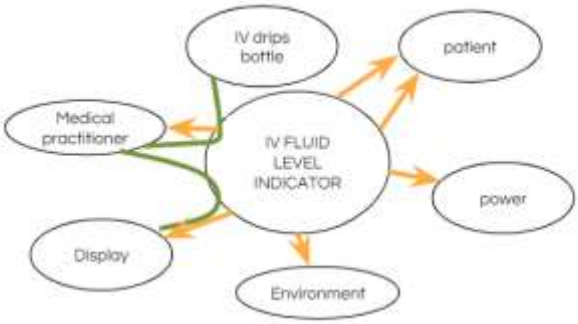

Fig - 2: Octopus diagram

The constraint functions are

- It shouldn't harm the patient.
- It should be portable and reusable.
- The display should be easily understandable.
- It should not disturb the patient.
- It should be battery operated.
- Easy handling.

4. EXISTING SYSTEM

One method comprises of IR sensor, RF transmitter, Receiver, buzzer, etc. Basically, IR transmitter transmits an IR ray which is received by the IR receiver and the measured output is in terms of voltage. Initially, IR sensors (IR Transmitter – IR Receiver) are placed at the bottom on either side of the saline bottle. The IR transmitter continuously transmits the rays through the saline liquid and the IR receiver starts to receive it and the corresponding output voltage is measured as 4.5V. When the medication liquid in the drips bottle goes beyond the area covered by the IR sensor, the IR receiver receives more rays than in the previous condition whose output voltage is measured as 5V.

Another system eliminates the constant manual monitoring of the level of liquid in a bottle is by using the load cell. The first intimation is given when 50 ml of liquid is left so that the hospital staff gets enough time to reach the room and replace the bottle. The second intimation is sent in the form of a call alert using a GSM modem to indicate the urgent need to replace the bottle.

5. PROPOSED SYSTEM

To indicate the level of IV fluid light dependent resistor(LDR) is used. It senses the light produced by the LED and produces the output. The LDR and the LED are fixed opposite to each other on either side of the IV fluid bottle at the near bottom of the bottle. Until there is a solution in the bottle up to the level set, the light received by the LDR will be low which increases its resistance. When the level of fluid in the bottle goes below the set level, the conductivity of the sensor increases. The Arduino controller is used which is set so as to compare the intensity of light that falls on the LDR with a predetermined value and if it increases, the circuit is programmed in such a way that the buzzer buzzes in the nurses' room indicating that the IV fluid is about to be over and the nurse/ medical assistant is needed to change the fluid.

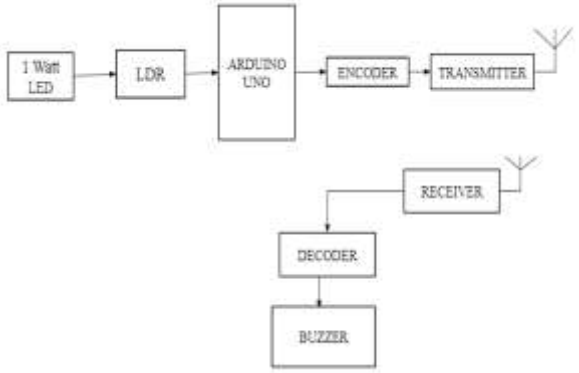

Fig - 3: Block diagram

6. COMPONENTS USED

The circuit diagram of the suggested intravenous fluid level indicator was developed based on the trial and error method. From the final circuit diagram, the various components needed for the design of the proposed system were identified and tabulated and the specification of each of the component used in the design was listed. The table below shows the list of the required components along with their specification.

Table - 1: List of components

Sl. No	Component	Specification
1	Light Emitting Diode	1 Watt
2	Light Dependent Resistor	RES 0276
3	Arduino UNO	R3 CH340G
4	Encoder	HT12E
5	Decoder	HT12D
6	RF Transmitter and Receiver	433 MHz
7	Buzzer	12 V

6.1 LED

The 1 Watt Light Emitting Diode acts as the light source for the setup. It is positioned on one side of the intravenous trips bottle.

6.2 LDR

The Light Dependent Resistor acts as the light detector. It is placed on the other side of the trips bottle on the exact opposite to the LED. Based on the intensity of the light that falls on it, its resistance varies.

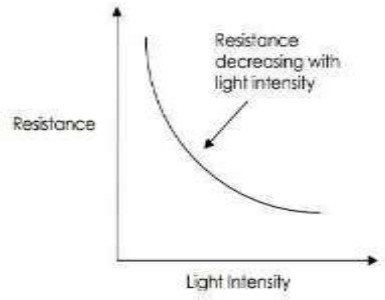

Fig - 4: Variation of resistance with light intensity.

6.3 Arduino UNO

Arduino UNO is an 8-bit microcontroller with 32KB flash memory. It is the main controller of the IV fluid level indicator. It is programmed in such a way so as to produce the output when the intensity of light sensed, changes.

6.4 Encoder - Decoder set up

HT12E encoder is employed for encoding the data to be transmitted. HT12D decoder is used for the decoding purpose which decodes the data received by the receiver from the transmitter.

6.5 RF Transmitter and Receiver setup

433 MHz RF transmitter and Receiver is used to transmit the data wirelessly to the nurses' room. Radio - frequency (RF) transmitter and receiver are used so that the signal can be transmitted to a distance of 2 km. The transmitter receives the data from the Arduino in the sending end. The receiver is connected to the buzzer in the receiving end.

6.6 Buzzer

The buzzer is used to indicate with a sound when the level of the IV fluid in the bottle goes down. This alerts nurse about the change or the removal of the IV drips bottle that is to being administered to the patient.

7. EXPERIMENTAL SETUP

The circuit for the intravenous fluid level indicator is designed using the above-mentioned components. The LED and LDR are placed on either side of the IV trips bottle and is connected to the Arduino controller. This indicates the level of IV fluid with the amount of light falling on it. The circuit diagrams are

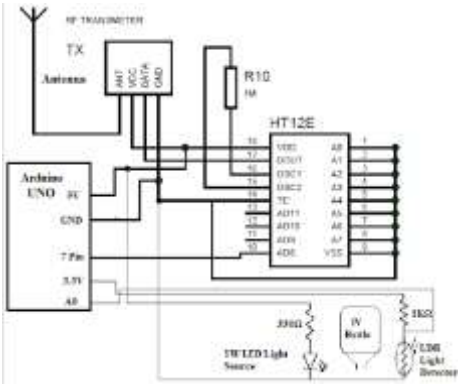

Fig - 5: Transmitter circuit

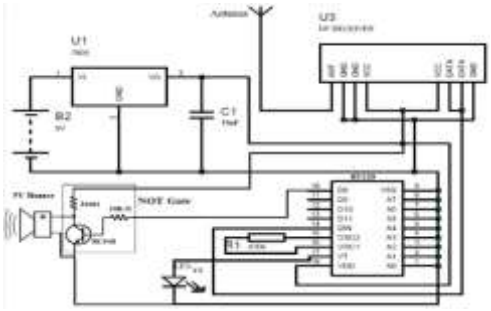

Fig - 6: Receiver Circuit

Fig - 5 and Fig - 6 represent the circuit connections for the transmitter and the receiver. This is the experimental set up with which intravenous fluid level is measured and indicated when it falls below the critical level. The Arduino controller is loaded with the program for initiating the alarm whenever the level if the intravenous fluid in the trips bottle goes below the critical level already set. The proposed intravenous fluid level indicator was designed and a small prototype was developed. Fig - 7, Fig - 8 and Fig - 9 are the prototypes developed to check the testing of the proposed system.

Fig - 7: Transmitter circuit with LED, LDR and Arduino

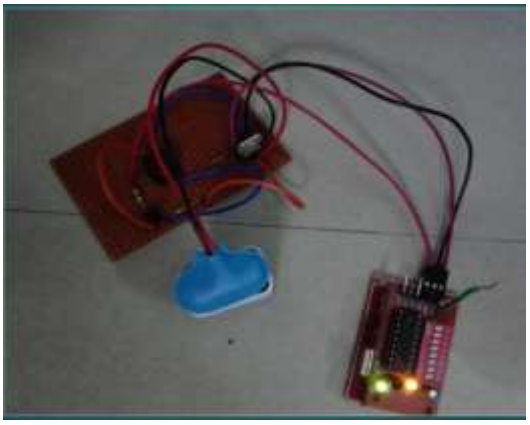

Fig - 8: Receiver circuit with Buzzer

Fig - 9: The entire setup of the intravenous fluid level indicator mounted on the stand

8. FUTURE ENHANCEMENT

With the design of the project, the future enhancements to be done were also listed down. Some of the ideas are listed below

- The program for Arduino should be altered such that the medical assistant can select the type of IV fluid being administered to the patient.
- Development of microelectromechanical systems that can cause automatic closure of the IV tube so that there is no back-flow of blood.
- The indication to be done along with sending a message to the nurse-in-charge using incorporation of GSM module.

9. CONCLUSION

The medical field is one of the rapidly emerging fields with various innovations coming up. The intravenous fluid level indicator is a much-needed system which can prevent manual errors and be a life savior. It helps to reduce the stress of the medical practitioner on the frequent need to check on the patient so as to take care of the IV fluid. The suggested intravenous fluid level indicator has various advantages such as the low cost, smaller size, high accuracy, and easy handling. This development will be an essential unit in the patient health monitoring system.

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