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# IOT Based Saline Level Monitoring & Automatic Alert System

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**Abstract:** As the world population is increasing, the need of health prevention is also increasing day by day. Hence, it is mandatory for everyone in this world to take care of their health properly. In these recent years, there is a rapid progress in medical care due to the technological advancements in the various fields of sensors, micro-controllers, and computers for assuring fast recovery of patients in the hospitals. The major and fundamental requirement of the hospitalized patients is that every patient should be provided with a better treatment and observation and should be supplied the correct amount of vital nutrition at the correct time. Among the various treatments, the saline therapy is the most important treatment that many patients receive from the hospitals. The bottle of saline is fed to the patients to treat dehydration and thus improve their health. In the hospitals, whenever a saline is fed to the patients, the patient needs to be continuously administered by a nurse or a care-taker. But unfortunately, there are some critical situations, i.e., patient's blood re-flexing back into the saline tubing system due to the negligence towards the saline completion and busy schedules of the responsible doctors, nurses, or the care-takers, so a huge number of patients are dying or are being harmed in the hospitals. Hence to prevent the patient from getting harmed and to protect their lives during saline feeding hours, the saline level monitoring and automatic alert system has been developed. The proposed system facilitates a sophisticated method of controlling saline drop rate by monitoring the saline system remotely by using Internet Of Things platform. The proposed system consists of a sensor used for monitoring the critical level of the saline liquid in the saline bottle and a mechanism that will stop the saline flow automatically after the saline bottle is completely empty. This proposed system can be utilized efficiently in homes as well as hospitals.

**Keywords:** Intravenous, Internet of Things, Node MCU

## I. INTRODUCTION

Internet of Things (IoT) is the network of physical objects comprising of all the devices, vehicles, buildings and the other items embedded with electronics, software and sensors which enables these objects to collect and exchange data amongst each other. The Internet of things has evolved due to convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems. Whenever a saline is fed to any patient, he/she needs to be constantly monitored by a nurse or any relatives. Most often due to negligence, inattentiveness, busy schedule and more number of patients, the nurse may forget to change the saline bottle as soon as it is totally consumed. Just after the saline finishes, blood rushes back to the saline bottle due to difference in blood pressure and pressure inside the empty saline bottle. This may cause reverse flow of blood to saline bottle from their vein. This results in the reduction of hemoglobin level of patients and may also lead to shortage of red blood cells (RBC's) in the patient's blood causing tiredness. Therefore, there is a need of developing a saline level monitoring system which will reduce the patient's dependency on the nurses or caretakers to some extent.

In this system, IOT based automatic alerting and indicating device where IR sensor is used as a level sensor. IR sensor output voltage level changes when intravenous fluid level is below certain limit. The comparator continuously compares the IR output with predefined threshold. When the transceiver output is negative then the Ardiuno controller identifies that the fluid level is too low and it alerts the observer by buzzer. When the saline drops down to a certain low level then an alarm generated to alert the nurse that the saline fed to the patient is over. The difference of weight is used to sense the amount of saline present in the bottle and hence is used to provide an audible alarm present in the indicator board at attendant or nurse room. If the nurse fails to attend the patient immediately then a motor arrangement is done which suppresses and flattens the saline tube. This prevents the upward flow of saline from the veins to the bottle.

Objectives :
The main objectives of this system are listed below as follows :

1. To overcome drawbacks in manually controlled saline system.
2. To provide greater accuracy than manual saline flow rate control system.

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3. To Avoid harms cause to patient health due to negligence towards saline completion.
4. To make the saline monitoring automatic and to Inform the doctor/nurse spontaneously for patient safety.
5. To automatically stop the flow after emptying of saline bottle.

## II. LITERATURE SURVEY

**Existing System:**
The existing system contains a IV set which is attached to the drips chamber. The flow sensor is used to detect each drops of IV set. For each drop, the beam of light is broken at each time and that is transmitted and received by IR sensor. This provides a change in sensor output and comparator gives a pulse output for each drop. The drip rate is indicated using the LCD with which the observer can identify the volume of fluid in IV set. If the device is not sensed for 45 seconds it will give an alarm.

The another system proposes a method of "Design and development of versatile saline flow rate measuring system and GSM based remote monitoring device". In this device an indigenously developed sensor is attached to the neck of the drips bottle. For every drop of the saline, the signal conducting circuit produces one pulse. The signal conditioning circuit consists of a multivibrator, comparator and phototransistor. The 8051 microcontroller is used to count the pulse in unit time. This will resemble the flow rate. Through GSM technology the information about the flow rate is send to the observer's mobile. The cost of this device is high. The disadvantage of this system is that it is expensive. To avoid various problems caused due to these systems, a new proposed system is being developed which is least expensive and easily usable.

**Proposed System:**
The Proposed system describes about the saline level monitoring & automatic alert system by using a rubber band mechanism in which rubbers are used and variuos software as well as hardware is used. The rubber band mechanism helps to easily detect the levels of saline water and the LED lights of the IR sensor glows accurately at each level of the saline bottle. Firstly while the saline bottle is feeded to the patient, the starting level will be completely full so the obstacle will cut the light rays of first IR sensor and the first LED of the IR sensor will be glown and the automatic alert message of partially filled bottle will be sent to the nurse, Similarly when the saline bottle is partially filled and partially empty then the obstacle will cut the light rays of second IR sensor and the second LED of the IR sensor will be glown and at last when the saline is becoming completely empty,then the same obstacle will cut the light rays of the third IR sensor and then the third LED of the IR sensor will be glown and the automatic alert message of completely empty saline bottle will be sent to the doctor as well as the flow of saline will be stopped automatically using a micro servo motor. As there may be negligence of nurses or doctors towards the patients or may be that they cannot reach patients so to avoid the reverse back flow of blood after completion of saline bottle, this micro servo motor is used to automatically stop the flow of saline immediately after the saline bottle is completely empty. Table 1 shows the varios levels and actions taken according to the levels of saline bottle.

Table 1 : Different Levels with effects on IR sensor and actions taken

| Different Levels | Effect on IR sensor | Action Taken |
|---|---|---|
| Completely filled | 1st LED glows | No Action Taken |
| Partially filled | 2nd LED glows | 1st Message send to nurse |
| Completely Empty | 3rd LED glows | 2nd Message send to Doctor & Automatic flow stop and buzzer beeps |

## III. SYSTEM REQUIREMENTS

- **Node mcu microcontroller :** NodeMCU microcontroller is an open source microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The NodeMCU ESP8266 micro-controller will be used as processing and programming unit for sending instructions to the micro servo motor, buzzer and the database.
- **Arduino IDE :** Arduino IDE is a platform on which programming will be performed for detecting level of saline water, automatically sending alert messages to the nurse and doctor as well as for beeping a buzzer when needed. In this Arduino IDE 1.6.12 version is used.
- **Android Studio :** Android Studio is the official Integrated Development Environment (IDE) for Google's Android operating system. The android studio is actually used for creating an application that will continuosly monitor the saline level and will automatically alert nurses and doctor whenever necessary.
- **IR Sensors :** An infrared sensor[IR Sensor] is an electronic device, that emits in order to sense some aspects of the surroundings.IR sensor will be positioned at the critical level of the saline on the saline bottle to sense the critical

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level of saline as well as saline completion status.

- **Rubber Bands :**The Rubber bands are used for lifting the saline bottle according to its flexibility and detecting the saline level using IR sensors.
- **Micro Servo Motor :** Micro servo motor is tiny and lightweight with high output power. This servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kind of servo motor but is smaller.
- **Buzzer :** Buzzer is an audio signaling device. Buzzer will alert the nurses, caretakers and doctors when saline reaches the critical level and for replacement of saline bottle.
- **Power Supply Unit :** Power supply unit converts main AC to low voltage regulated DC power for the internal components of the computer.It will supply power to the rest of the components of the proposed saline level monitoring and automatic alert system.
- **Database :** Database will store the information about the pateint, the room number, the saline number as pateint 1 will saline 1 in room no 1 and so on. The levels of saline bottle will be continuosly updated in the database as well.

## IV. DESIGN PHASE

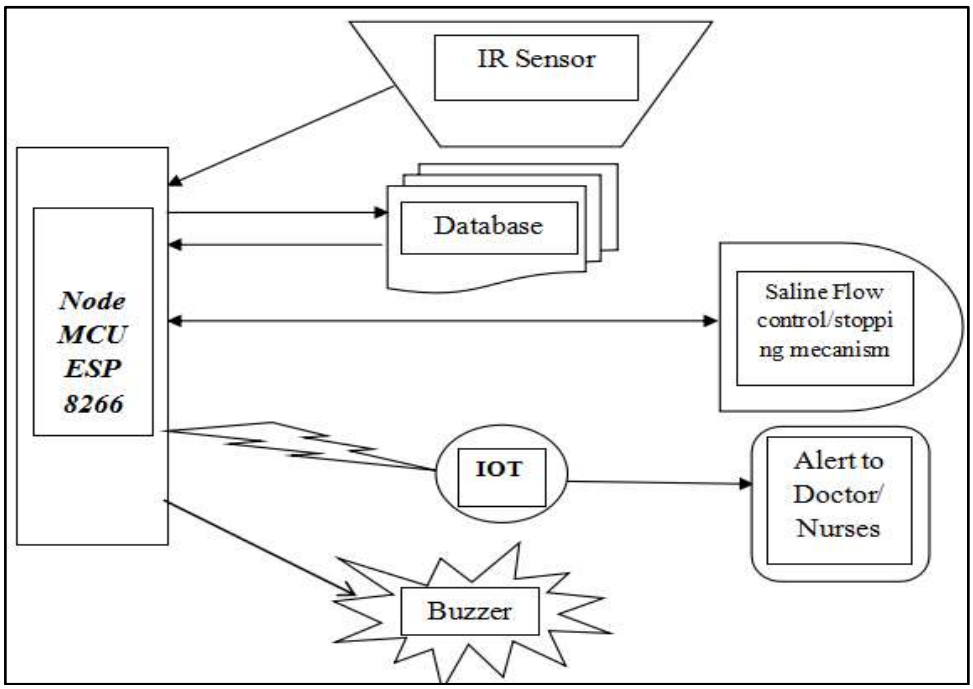


Fig 1.1 : Block Diagram of Saline Level Monitoring & Automatic Alert System

The above figure shows the mechanism for saline Level Monioring and Automatic Alert System. In this mechanism, first whenever a saline bottle is fed to the patient, the patients is always adminitered by the nurse or the care taker so that the patient does not get any harm. But due to the busy schedule of nurse or doctor, it may happen that the saline bottle is consumed completely by the patient and there may be nobody present near the patient to change the saline bottle and may cause reverse flow of blood from the saline tubing due to which sometimes patient's health becomes weaker or may die. So to avoid these kind of problems that may cause harm to patients, this sytem has been evolved.

This system is aimed in automating the saline level monitoring system using Node MCU kit and saline level can be precisely controlled. Also human can contact the system. If saline level monitoring system is failed to disconnect the drip system to patient, Air-in line sensor will be activated. All most in all hospitals, assist / nurse is responsible for monitoring the saline level system. But unfortunately, the observer may forget to change or stop the drip bottle at correct time due to their schedule. This may leads to several problems to the patients. Our project is overcome for this critical situation. This technology reduces the work of the observer.

This proposed system also provides a saline flow control/ stopping mechanism due to which whenever a saline is consumed completely and whether there may be any nurse or care taker present or not, it will automatically control or stop the flow of saline. This may lead to patients improvement in health.

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Use Case Diagram :

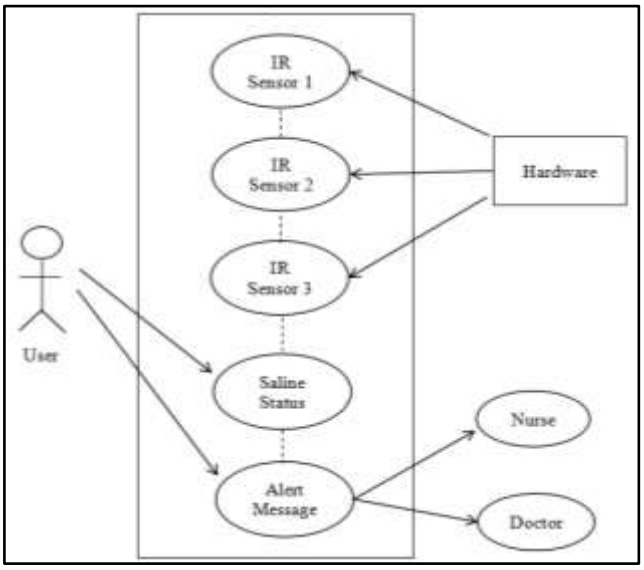


Fig 1.2 : Use case Diagram of proposed System

Flowchart :

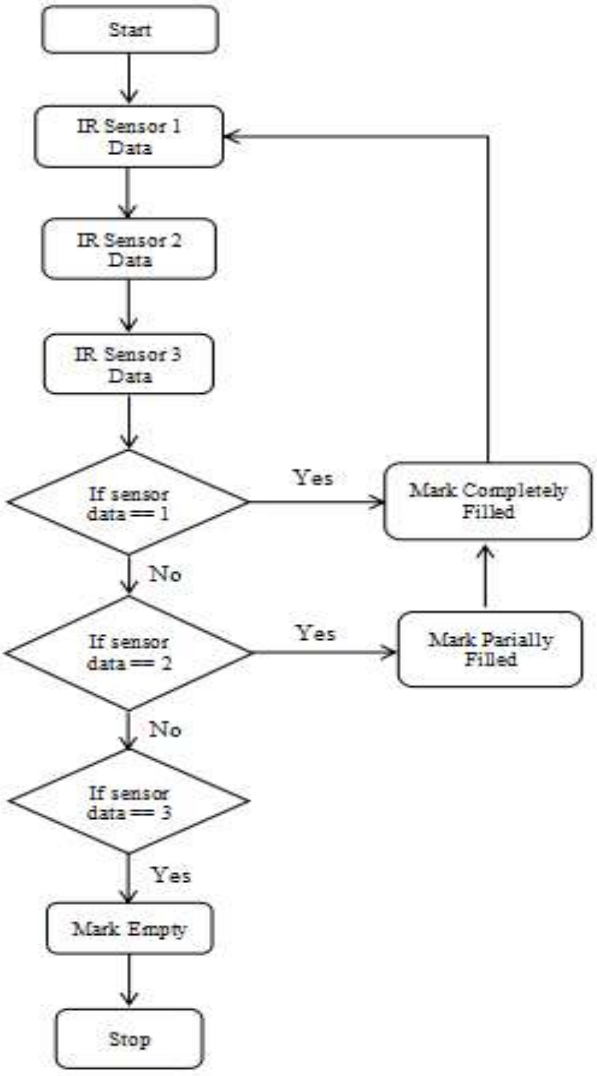


Fig 1.2 : Flowchart of proposed System


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## V. FUTURE SCOPE

This project can also be added to smart card attendance system so that the controller gets the detail of absentee of a faculty and also can send message to doctor about the absence of faculty and alert another faculty to take position of that absented faculty. The flow control mechanism proposed can be modified and used in other fields such as chemical mixing. The devices used in our project can be replaced by any alternative or better mechanism can be used for pressing and the proposed work can be interfaced with keypad for better results. In future, the system can be extended to a distributed wireless network system. The flow control mechanism proposed can be modified and used in other various fields. Furthermore, with the development of embedded hardware, more complex embedded coding can be done. The sending and receiving speed of a security alert message is high, so this can be used to give more kinds of applications in the future.

## VI. CONCLUSION

With IoT based saline level monitoring system, the manual effort on the part of the nurses is saved. As the entire proposed system is automated, it requires very less human intervention. Itwill be advantageous at night as there will be no such requirement for the nurses to visit patient's bedevery time to check the level of saline in the bottle since an alert notification will be sent to the nurses, doctors, caretakers when saline reaches the critical level. It will save the life of the patients. This will reduce the stress in continual monitoring by the doctor or nurse at an affordable cost. This automatic saline level monitoring system provides more flexibility to doctors, thereby the patients caring is enhanced. Hence it saves lots of time for doctor or nurse who is on duty. It also proposes the system which can automatically monitor the saline flow by using micro controller. The system is reliable, cost effective and convenient for nurses. It can be reused for the next saline bottle. The system helps nurses to monitor the saline flow from a distance. It is mainly advantageous at night timing as there is no need for nurses to go to patient's bed to check the level of saline in the bottle.

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