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AUTOMATIC SALINE LEVEL MONITORING SYSTEM USING IOT

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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. Or at particular level. This is of high advantage to the patients especially during night times. This system also avoids the fatal risk of air bubbles entering the patient's bloodstream, which is a serious threat as air bubbles in blood can cause immediate death. Such a device will create assurity of non-harm condition to patients. .

Index Terms **- Automatic Saline Monitoring, IOT, Microcontroller ATMEGA328, IR Sensor.**

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 Arduino controller identifies that the fluid level is too low and it alerts the observer by web page or App. When the saline drops down to a certain low level then an notification 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 Smartphone based app or computer based web page at attendant or nurse room. If the nurse fails to attend the patient immediately then a sensor block the arrangement is done. Which suppresses and flattens the saline tube. This prevents the upward flow of saline from the veins to the bottle.

II. BLOCK DIAGRAM

We designed and developed the entire idea into a device, where we integrate all the mentioned components into a single unit.

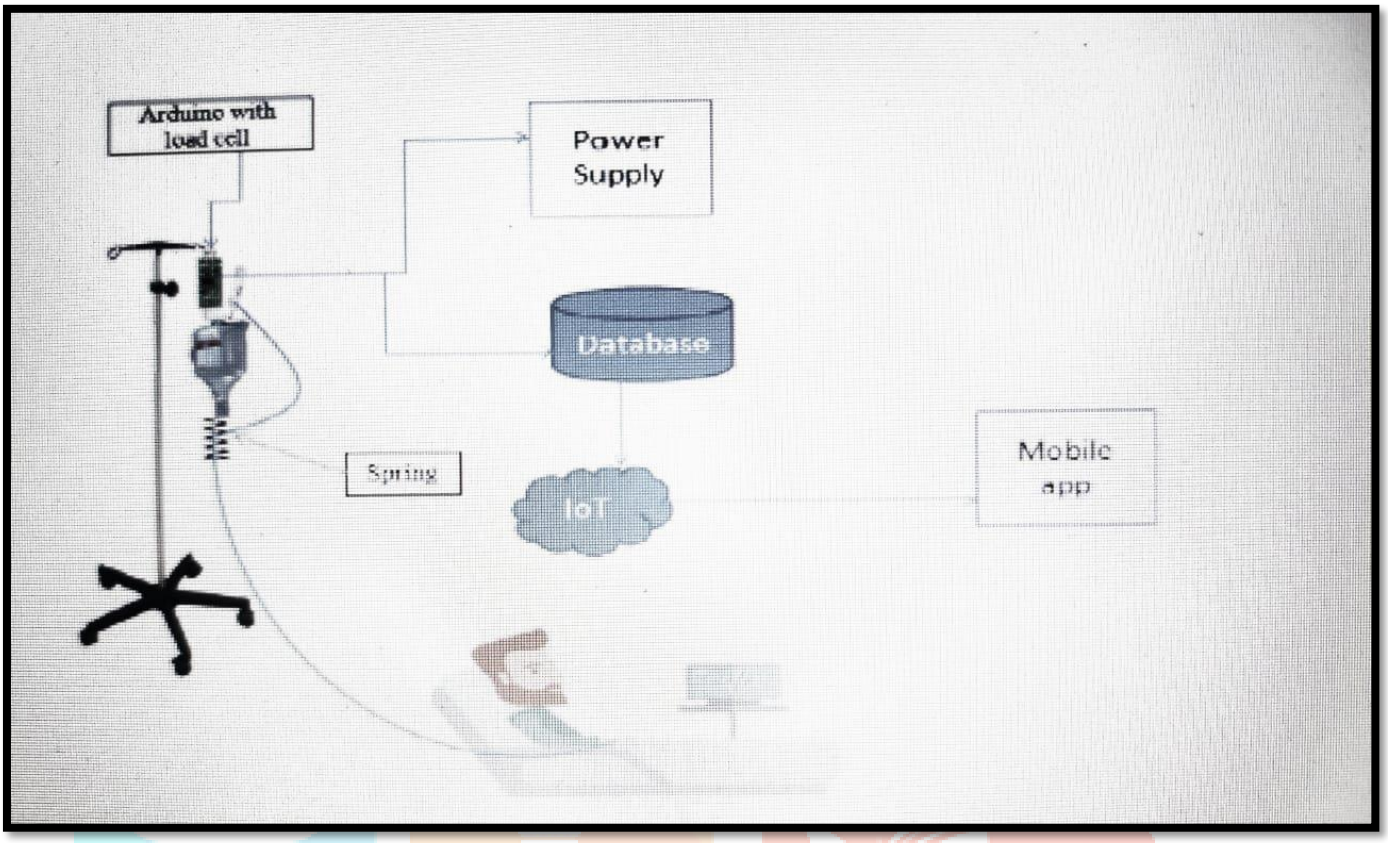

Fig. Block diagram of Automatic Saline Level Monitoring System

2.1 COMPONENTs

ESP8266:

The ESP8266 WiFi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all WiFi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

There is an almost limitless fountain of information available for the ESP8266, all of which has been provided by amazing community support. In the *Documents* section below you will find many resources to aid you in using the ESP8266, even instructions on how to transform this module into an IoT (Internet of Things) solution.

Arduino Nano:

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one.

HX711:

The dual-channel 24 Bit Precision A/D weight Pressure Sensor Load Cell Amplifier and ADC HX711 Module is a small breakout board; for the HX711 IC that allows you to easily read load cells to measure weight. By connecting the module to your microcontroller you will be able to read the changes in the resistance of the load cell; and with some calibration. You'll be able to get very accurate weight measurements. This can be handy for creating your own industrial scale, process control, or simple presence detection. The HX711 Weighing Sensor uses a two-wire interface (Clock and Data) for communication. Any microcontroller's GPIO pins should work and numerous libraries have been written making it easy to read data from the HX711.

LOAD CELL:

The load cell is used in this work as a weight sensor. The rated load of this load cell is 5 kg with maximum working voltage 15 V DC. It is placed on the medical Intravenous. The saline bottle is suspended on the load cell. This strain-gauge load cell converts the saline weight into electrical signals and then sends to the weight sensor amplifier module (HX711) before going to the microcontroller.

POWER SUPPLY:

The supply unit consists of battery, basic filter and regulator IC 7805 which is used to provide supply voltage of 5v. There is a provision of using transformer as well as adaptor of 12volt and 1 ampere current. If transformer is used then bridge rectifier and 1000 microfarad capacitor is provided.

2.2 WORKING OF PROJECT

We designed and developed the entire idea into a device, where we integrate all the mentioned components into a single unit.
Different wires in Load cell: Excitation+ (E+) or VCC is red, Excitation-(E-) or ground is black, Output+ (O+), Signal+ (S+) + or Amplifier+ (A+) is white, Output-(O-), Signal- (S) + or Amplifier-(A-) is green.
HX711 is connected to Arduino Uno through VCC to 5V, GND of HX711 to GND of Arduino, SCK of HX711 to D5 of Arduino, and DT of HX711 to D6 of Arduino.
Load Cell is connected to HX711 through E+: RED, E: BLACK, A- : WHITE, A+: GREEN. Entire Connection is shown below in Fig.

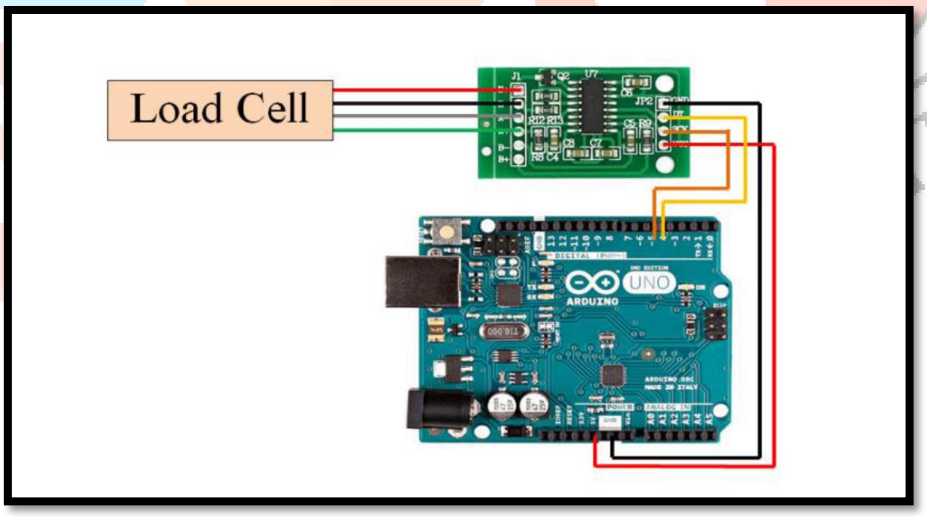

Fig. Connection of HX711 to Arduino UNO and load cell to HX711.

All the components are connected as shown in the block diagram Fig . Initially, we connect the load cell to the Arduino through the HX711 module. HX711 module is useful in detecting the loads that are placed on the loadcell. The saline bottle is hanged to the loadcell using a hook. Loadcell detects the weight of the Saline bottle. We initially set some particular threshold in the code written. If the weight of the Saline bottle reaches the threshold, our system sends Alert Notification to the hospital management. In the Alert Notification sent we can see the current level of the Saline bottle.

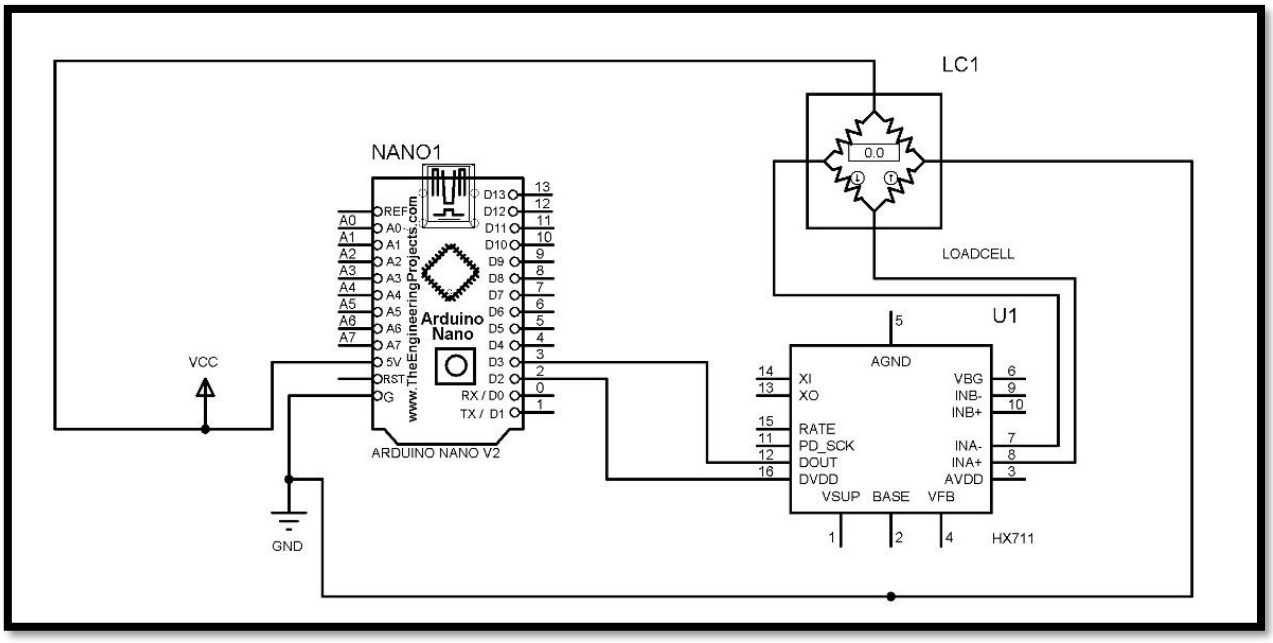

Fig. Circuit Diagram of Automatic Saline Level Monitoring System.

III. LITERATURE SURVEY

Innovative use of IoT technology in healthcare provides not only benefits for doctors and managers to access many different data sources, but also challenges in accessing heterogeneous IoT data, especially in the mobile environment in real-time IoT application system. The big data collected by IoT devices creates the problem for IoT data interests. The purpose of the review is to visualize existing technology in location-based healthcare services and make use of this technology for development in future discoveries. In addition, the study helped us understand the many flourishing and existing health technologies such as ECG, EMG monitoring through Android apps, using different protocols to transfer data like MQTT, TCP / UDP, OCN-authenticated technologies, WLAN etc. we analyse the wireless health monitoring system of human temperature and heartbeat patients. The hardware is implemented and the output is studied. The traditional methods used for health care are becoming obsolete due to population increase. Today's healthcare system requires manual care and its heavy tasks, which is time consuming. Innovative health monitoring systems with less human intervention are needed, which will be available at low cost in rural and urban areas. Engineering technologies are being coupled with the medical field to solve this problem. Thus, sophisticated health monitoring systems are being developed with the help of easily interfaced electronic components such as sensors, PLCs, microcontrollers etc.. This article focuses primarily on providing advanced saline level monitoring system. As the world's population grows, so does the need for health care. In recent years, progress in health care has been rapid due to advances in the field of sensors, microcontrollers and computers. One of the main reasons for this is the combination of the two important disciplines, namely medicine and engineering. This paper describes the development of an automatic saline monitoring system using an indigenous developed low cost sensor with IoT device this allows the attending physician or nurse to monitor the saline flow rate at a distance.The critical level which is sensed by the IR sensors. This sensed output is sent to the microcontroller which scans the database for retrieving the contented information. The detection of saline drop rate is quite reliable.

Implemented framework comprises of different sensors and devices and they are interconnected by means of remote correspondence modules. The sensors data is been sent and received From nurse or doctor end utilizing Internet connectivity which was enabled in the Node MCU module-an open source IoT plat-form. This system is used to observe the condition of patient. The data can be viewed on the Thing Speak app or any web page. The nurse can observe all the levels, or the range that is performed.

Generally saline bottle contains 500ml solution. In general the critical limit is set as 70ml. As soon as the saline level reaches the critical limit, the voltage changes and the IR sensor senses it. Now the IR Transmitter passes this voltage change signal to IR receiver. IR receiver signals the Arduino micro-controller about this condition. The Arduino micro-controller sets the notification to the App or a web page.

IV. IMPLEMENTATION

Fig. Whole Setup

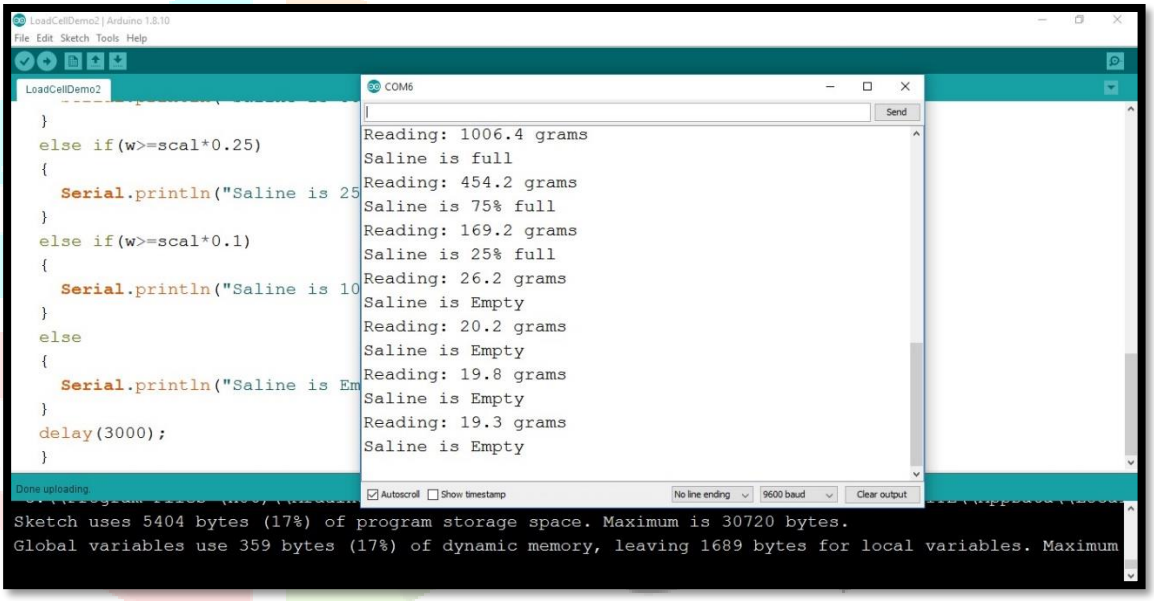

Fig. Programming of Arduino on Arduino Software (IDE)

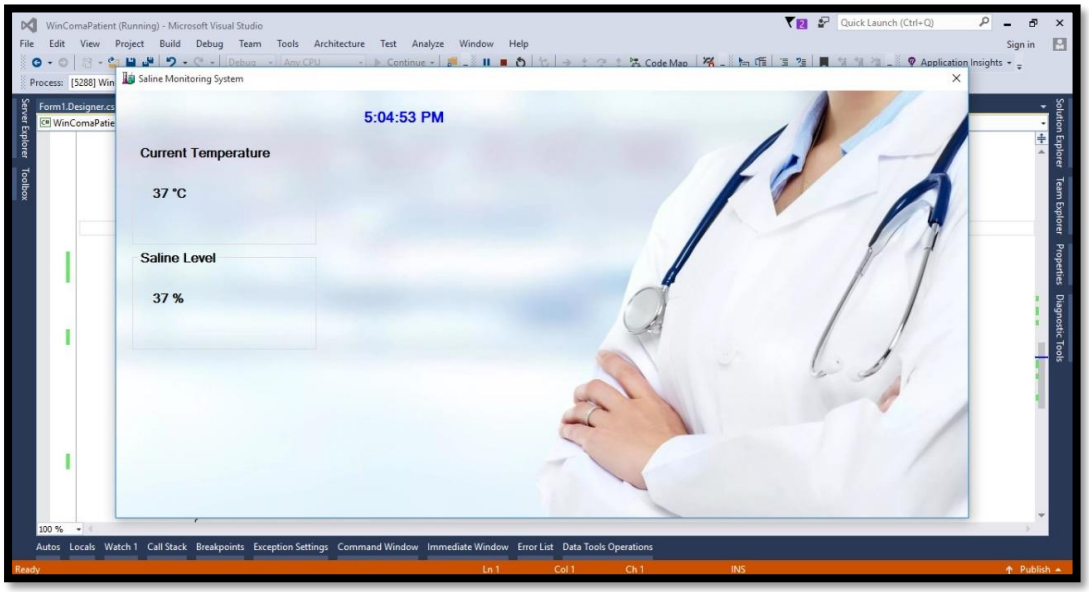

Fig. Output Notification

V. ADVANTAGES:

- Every time it is not necessary to watch a patient who is injected Saline bottle. Continuous monitoring of bottle is not required.
- The system is simple to use.
- As our phone App or web page gets Notification, the staff get alerted immediately. There is no chance of backflow.
- Man power can be reduced.
- User friendly.
- Free of noise.
- This system is reliable and cost effective.
- No safety requirements is been needed as our system is purely software oriented

VI. DISADVANTAGES:

- In case of sensor failed to detect level the system will not work properly. It can Cause patient health.
- The current system is used for normal inpatients only. Under abnormal conditions, patients depend on nurses or doctors.

VII. APPLICATION:

- By using this system the patient can be analysed by doctors in any part of the hospital.
- The whole health monitoring system, which we have proposed can be integrated into a small compact unit as small as a cell phone.

VIII. RESULT:

The programming is based on Arduino platform which is done using C compiler. The results are obtained on Web page or Smartphone App with the help of Bluetooth terminal software and are obtained on computer or laptop using serial port test software. The results contain number of droplets coming from saline bottle, the solution given to patient in ml, the droplet rate and remaining solution in bottle.

IX. 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. It will be advantageous at night as there will be no such requirement for the nurses to visit patient's bed every 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.

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