



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 4, April 2023

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

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# Smart Intravenous Fluid Monitoring System

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**ABSTRACT:** Saline, one of the most popular intravenous (IV) therapy plays a major role in the management of patients who are critically ill. During recent years, due to the technological advancements many sophisticated techniques has been evolved for assuring fast recovery of the patients in hospitals. Surveillance of saline bottle level is very important because when the bottle is emptied and the needle is not removed from the vein then the blood flows outward into the bottle. In hospitals, the nurses or caretakers are responsible for monitoring the saline bottle level. Mostly, due to negligence and any unusual condition, the exact timing of removing the needle from the patient's vein is ignored which causes a serious casualty and may lead to death as well. To prevent the accident due to the ignorance of caretakers and to provide remote surveillance in telehealth services, we have proposed the cost-effective smart saline level monitoring device which includes the combination of sensor and Internet of Things (IoT) technologies. We have built this system by using load sensor and HX711 low cost ESP8266 Wi-Fi System on Chip (SoC) microcontroller. The load sensor converts the weight of the bottle to a specific voltage and HX711 will monitor to saline. IR sensor is also implemented in project for monitoring weather there is reverse flow of blood is there or not. The ESP32 microcontroller generates and publishes a specific message based on the voltage received from the sensor and online notification alert through mobile widget. To publish and present the online messages to the devices (e.g. smartphone, tablet, laptop etc.) of subscribers like doctors, nurses or caretakers. We have also used temperature sensor for temperature monitoring of patients. This proposed monitoring system fulfills the reliable delivery of online messages to the subscribers which is very important for healthcare through mobile widget.

**KEYWORDS:** IoT technology, Empty detect emergency alert nurse, Wi-fi, load cell, Temperature sensor, HX711, IR sensor and buzzer.

## I. INTRODUCTION

The present patient monitor systems in hospitals allow continuous monitoring of patient vital signs, which require the sensors to be hardwired to nearby, bedside monitors or PCs, and essentially confine the patient to his hospital bed. Even after connecting these systems to a particular patient, a paramedical assistant need to continuously monitor and note down all the vital parameters of a given patient by keeping track of all of his/her records manually. Adopting such a method is error prone and may lead to disaster in the case of a human error. In our project proposed system, the patient health is continuously monitored by the Mobile multi patient monitoring system and the acquired data is transmitted to a centralized controller. The patient monitor system that consumes very low power and is extremely small in size. This project was especially designed for low power consumption.

## II. OBJECTIVE

- The main objective of this system is to provide reliable, convenient, effortless and cost effective system for saline level of controlling the sugar level.
- The saline is injected into blood by considering certain parameters like bottle level. As the saline goes below the critical level, it is necessary to change the saline bottle.
- An automatic saline level monitoring consists of load cell which are used to determine the status of liquid in the bottle whether it is normal or warning status and temperature sensor to monitor patients body temperature. Buzzer sound will be indicated to the nurse and online notification will send to mobile application. Data will be stores through the IoT technology as a graph level.

- The ESP device which is best suitable for making the system cost effective. If any critical condition means the online notification send to nurse or doctor with the help of mobile widget.

### III. LITERATURE SURVEY

Normal saline is generally referred as sterile solution of sodium chloride (NaCl) in water. The sodium chloride sterile solution is used for nasal irritation, rinsing contact lenses, intravenous infusion and to clean a new piercing. It is often, to use Normal Saline in intravenous drips (IVs), or the patients who are unable to take fluids orally and are in danger of causing dehydration or hypovolemia. The amount of Normal Saline intake taken by patient is totally depends on physiological condition of patient but normally it is between 1.5 to 3 liters per day for an adult. Generally, in hospitals saline level is monitored by nurses and patients relatives. [1] There is always a need to check the saline level after certain time. The existing system for saline level monitoring is very time consuming and inconvenient for nurses. [2] Increase in the population, there is a need for improvement in health care. Because of the advancement in technology, the progress in medical field is rapid. A reason behind this is nothing but the combination of medical and engineering disciplines. When the Normal Saline (NS) is to be placed intravenously then it is called as sterile. [3]

### IV. EXISTING SYSTEM

- The system is composed of four components: Load Sensor, ESP32 Wi-Fi Chip, MQTT-S Broker/Server and MQTT-S Client.
- The load sensor is fixed on saline hanger and bottle is hung on it. This sensor converts the varying weight of the bottle into different voltages.
- So, each level of saline weight corresponds to some specific voltage. The output voltage from the load sensor is fed in the ESP32 Wi-Fi chip.
- Out of the continuous input voltage received, when the specific voltage of interest is obtained, ESP32 will produce the suitable output message such as FULL, ALERT and CRITICAL.
- In existing system saline monitoring was implemented and there is no proper alerting system for saline monitoring.
- In existing system there is no application used for individual online message alert.
- This device as lots of complexity to use and cost of this device is also high.

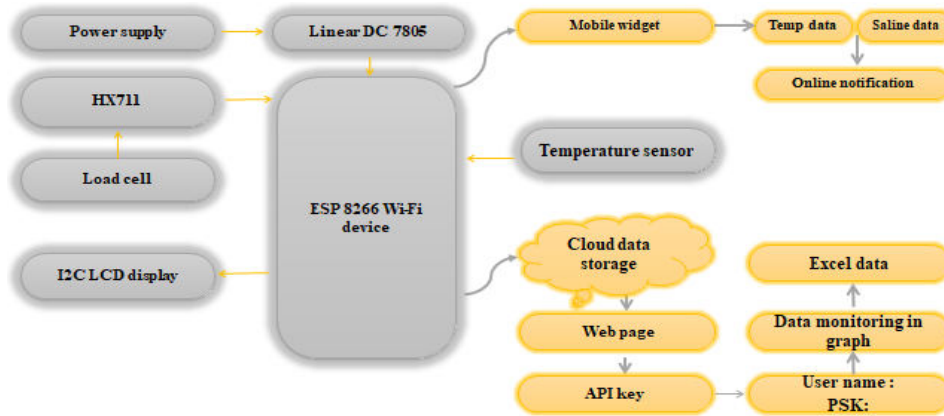
### V. PROPOSED SYSTEM

- In the proposed system, the weight of the saline bottle can estimate the liquid level that the liquid will reach its minimum level, the ESP8266 Wi-Fi module is used to send alerts through the mobile widget.
- The load sensor works on the principle that on applying a mechanical load, the piezoelectric material of strain gauge in the load cell deforms that leads to change in resistance and thereby the output voltage will change. So, the load cell in a sensor acts as a transducer that converts load into measurable electrical output. This load cell monitor weight of saline and HX711 will to convert the measured changes in saline value changes, through the conversion changes.
- This analog output is fed to the HX711 chip which amplifies and converts the analog voltage into a digital voltage. Further, the amplified output voltage from the HX711 chip is fed in one of the GPIO input pin of the ESP8266 controller.
- We have programmed ESP8266 in such a form that it will generate the suitable message corresponding to the value described and send that message related to the subscribed topic ID to the registered subscriber like doctor, nurse, caretakers, through online.

#### A. Advantages

- The patient can be monitored remotely by the nurse, caretaker, doctor etc.
- With this device we can monitor patient's condition and change saline immediately without life risk.
- This device is reliable to use and has less complexity.

**VI. BLOCK DIAGRAM**



**Fig no:1 proposed for block diagram**

**VII. HARDWARE REQUIREMENT**

**1. POWER SUPPLY**

The present chapter introduces the operation of power supply circuits built using filters, rectifiers, and then voltage regulators. Starting with an AC voltage, a steady DC voltage is obtained by rectifying the AC voltage, then filtering to a DC level, and finally, regulating to obtain a desired fixed DC voltage. The regulation is usually used for regulate the voltage from an IC voltage regulator unit, which takes a DC voltage and provides a somewhat lower DC voltage, which remains the same even if the input DC voltage varies, or the output load connected to the DC voltage changes.



**Fig no 1: Power supply**

**2. LCD DISPLAY**

The present chapter introduces the operation of power supply circuits built using filters, rectifiers, and then voltage regulators. Starting with an AC voltage, a steady DC voltage is obtained by rectifying the AC voltage, then filtering to a DC level, and finally, regulating to obtain a desired fixed DC voltage. The regulation is usually obtained from an IC voltage regulator unit, which takes a pure DC voltage and provides a somewhat lower DC voltage amplify signal, which remains the same even if the input DC voltage varies, or the output load connected to the DC voltage changes. An LCD is a small low-cost display. it is easy to interface with a micro-controller because of an embedded controller (the black blob on the back of the board). This controller is standard across many displays (HD 44780), which means many micro-controllers have libraries that make displaying messages as easy as a single line of code.



**Fig no 2: LCD display**



### 3. LOAD CELL

Load cells are used to measure weight of the object. They are used to integral part of our daily life. "In your car or at the cheese counter in the supermarket – we encounter load cells everywhere," says HBM Product Manager Stefan Schmidt. Of course, they are usually not immediately recognizable, because they are hidden in the inner workings of instruments to detect the data. Load cells generally consist of a spring element on which strain gauges have been placed to detect the load. The spring element is usually made of steel or aluminum materials. That means it is very usefully to study, but also minimally elastic material. As the name "spring element" suggests, the steel is slightly deformed under load, but then returns to its starting position, responding elastically to every load analysis. These extremely small changes can be acquired with strain gauges measure the data. Then finally the deformation of the strain gauge is interpreted by analysis electronics to determine the weight.

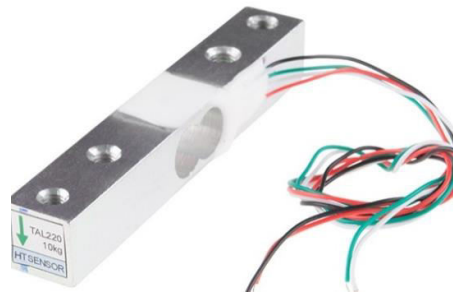


Fig no 3: Load cell

### 4. REGULATOR

In this tutorial, we will see all developments about one of the most commonly used regulator IC's, the 7805 Voltage Regulator IC used to regulate power. A regulated power supply is very much essential for several electronic devices due to the semiconductor material employed in them have a fixed rate of current as well as voltage and power regulation. The device may get damaged if there is any deviation from the fixed rate power. One of the important sources of DC Supply are Batteries proper supply. But using batteries in sensitive electronic circuits is not a good idea as batteries eventually drain out and lose their potential over time protect. Also, the voltage provided by batteries are typically 1.2V, 3.7V, 9V and 12V. This is good for circuits whose voltage requirements are in that range. But, most of the TTL IC's work on 5V logic and hence we need a mechanism to provide a consistent 5V Supply proper delivery.

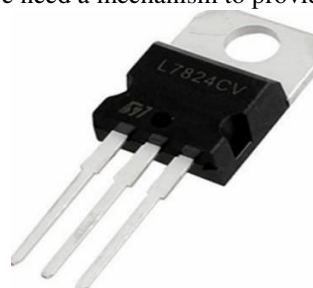


Fig no 4: Regulator

### 5. BUZZER

A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles and many sectors. It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. Initially this device was based on an electromechanical system which was identical to an electric bell without the metal gong (which makes the ringing noise) many buzzer application this device using. Often these units were anchored to a wall or ceiling and used the ceiling calling bell or wall as a sounding board. Another implementation with some AC-connected and DC devices was to implement a circuit to make the AC current into a noise loud enough to drive a loudspeaker and hook this circuit up to a cheap 8-ohm speaker.



Fig no 5: Buzzer

## 6. Hx711

Based on Avia Semiconductor's patented technology, HX711 is a precision 24-bit analog-to-digital converter (ADC) designed for weigh scales and industrial control applications to interface directly with a bridge sensor can be used to amplify the signal data. The input multiplexer selects either Channel A or B differential input to the low-noise programmable gain amplifier (PGA). Channel A can be programmed with a gain of 128 or 64, corresponding to a full-scale differential input voltage of  $\pm 20\text{mV}$  or  $\pm 40\text{mV}$  respectively, when a 5V supply is connected to AVDD analog power supply pin. Channel B has a fixed gain of 32. Onchip power supply regulator eliminates the need for an external supply regulator to provide analog power for the ADC and the sensor to get the voltage. Clock input is flexible some frequency. It can be from an external clock source, a crystal, or the on-chip oscillator that does not require any external component. On-chip power on-reset circuitry simplifies digital interface initialization and gain amplify. There is no programming needed for the internal registers selection. All controls to the HX711 are through the pins.

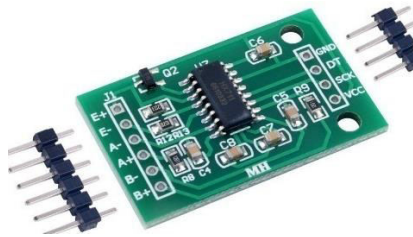


Fig no 6: Hx711

## 7. WIFE DEVICE

ESP8266 is Wi-Fi enabled system on chip (SoC) module developed by Espressif system to transfer data. It is mostly used for development of IoT (Internet of Things) embedded applications. It employs a 32-bit RISC CPU based on the Tensilica Xtensa L106 running at 80 MHz (or over clocked to 160 MHz). It has a 64 KB boot ROM, 64 KB instruction RAM and 96 KB data RAM. External flash memory can be accessed through SPI. ESP8266 module is low cost standalone wireless transceiver that can be used for end-point IoT developments. To communicate with the ESP8266 module, microcontroller needs to use set of AT commands. Microcontroller communicates with ESP8266-01 module using UART having specified Baud rate-9600. There are many third-party manufacturers that produce different modules based on this chip.

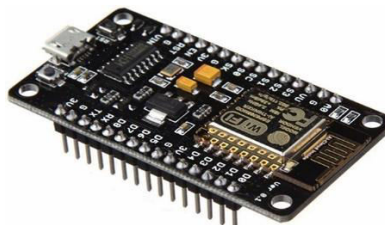


Fig no 7: Wi-Fi device

## 8. TEMPERATURE SENSOR

National Semiconductor's LM35 IC has been used for sensing the temperature. It is an integrated circuit sensor that can be used to measure environmental sense temperature with an electrical output proportional to the temperature (in SOC) to detect. The temperature can be measured more accurately with it than using a thermistor sensor can be used data the temperature value. The sensor circuitry is sealed and not subject to oxidation, etc.



|| Volume 12, Issue 4, April 2023 ||

| DOI:10.15680/IJIRSET.2023.1204041 |

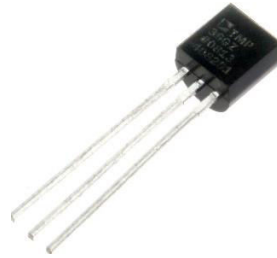


Fig no 8: Temperature sensor

### VIII. RESULTS

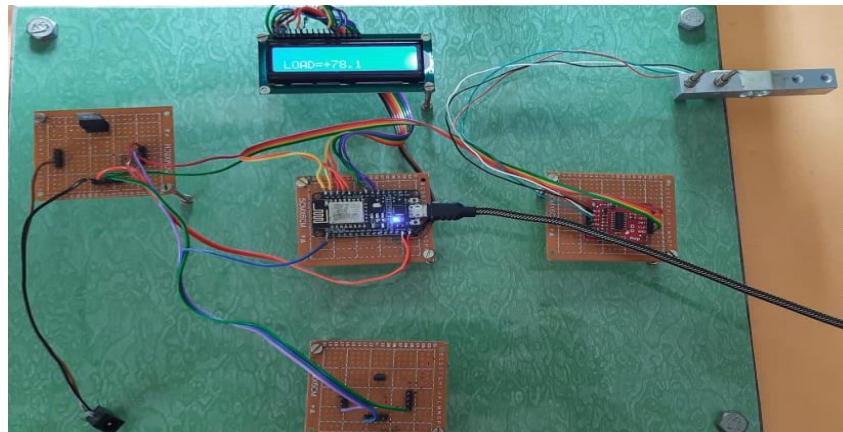


Fig no 1: Output

## IOT BASED SALINE LEVEL MONITORING

Channel ID: 2096603  
Author: mwa0000029776417  
Access: Public

Private View Public View Channel Settings Sharing API Keys Data Import / Export

+ Add Visualizations + Add Widgets Export recent data

MATLAB Analysis MATLAB Visualization

### Channel Stats

Created: [about an hour ago](#)  
Last entry: [less than a minute ago](#)  
Entries: 62

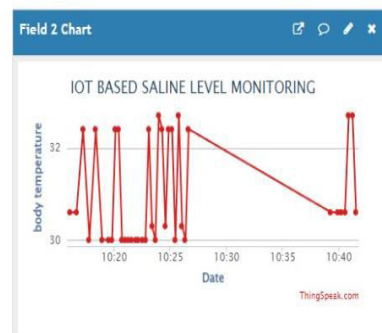
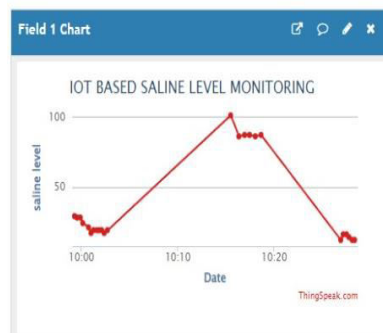


Fig no 2: ThingSpeak web page



## IX. CONCLUSION

Nurses who cannot monitor all patients at same time, they may get confused due to lots of patients, so monitoring all the patients at the same time will be become difficult sometimes, for that we have come up with a solution, by developing a device which will monitor on patient temperature, patient salinity level in glucose level to prevent tissue damage which will cause due to reverse flow of blood in salinity blood if glucose gets over which may result in high risk life of patients. With this project we can immediately change saline bottle and check temperature of patient in through mobile widget and take immediate action and can save many patients.

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