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Smart Saline Bottle

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***Abstract**: Most of the time, in hospitals, to improve the body's hydration, Intravenous Therapy (IV) is given. During the therapy, the bottle's liquid level needs to be monitored continuously. The bottle needs to be changed immediately, once it got empty, to prevent the blood's reverse flow through the intravenous tube. Any lack of monitoring or continuous assessment of the liquid level and the delay in refilling the bottle may cause adverse effects. To minimize the risk factor of the treatment and reduce the workload of the nurse/hospital staff, an IoT – Based Liquid Level Monitoring System has been developed. This system measures the liquid level continuously using a load cell sensor. Whenever the fluid level drops down below a threshold point, an instant alert is made to the concerned nurse/staff using Arduino. Thus this system becomes useful for nurses and patients during day time as well as night-time.*

Keywords: Medical assist device, IoT, Arduino, Load cell, Buzzer Alarm

1. INTRODUCTION:

Internet of Things is comprising of physical components, devices, and other items embedded with hardware, software, and sensors and which enables these objects to collect and exchange data amongst each other. IoT has arised due to the convergence of many technologies, real-time analytics, machine learning, commodity sensors, and embedded systems. Whenever saline is fed to any patient, he/she needs to be monitored continuously by a nurse or any relatives. Due to negligence, inattentiveness, busy schedule, and more patients, the nurse may forget to change the saline bottle as soon as it is consumed. Just after the saline finishes, blood rushes back to the saline bottle due to the difference in blood pressure and pressure inside the empty saline bottle. It may cause a reverse flow of blood to the saline bottle from their vein.

It reduces patients' haemoglobin level and may lead to a shortage of red blood cells (RBCs) in the patient's blood, causing tiredness. Therefore, there is a need to develop a saline level monitoring system[2] that will reduce the patient's dependency on the nurses or caretakers to some extent.

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2. SYSTEM ARCHITECTURE

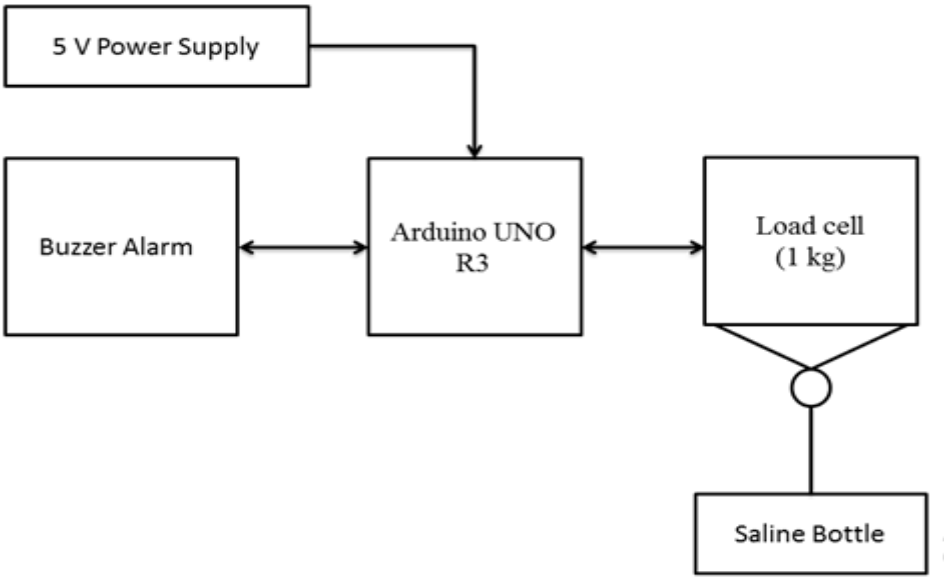

Fig.1 Block Diagram of Smart Saline Bottle

3. IMPLEMENTATION SETUP

A. Components

- Load Cell
- Load Cell sensor 24 bit ADC-HX711
- Arduino UNO
- Buzzer Alarm
- LED

B. Load Cell

A load cell is a type of active transducer, which converts mechanical input into an electrical output, which needs to be weighed probably uses a load cell to do so. Load cells come in many different shapes and sizes to be added to various machinery and weighing equipment.

Using load cell, we measure the weight of the glucose bottle. Its output will be analog. The maximum weight estimated in the load cell is 1kg. If the glucose bottle's weight is below 300ml or 0.3 kg, the buzzer alarm and the LED is triggered.

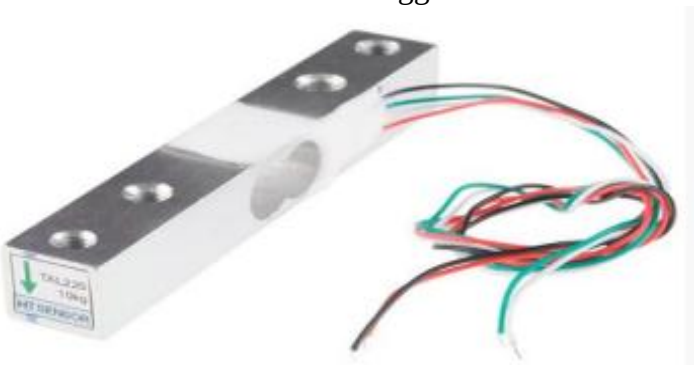

Fig. 2 Load Cell

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C. Load Cell Sensor 24 Bit ADC-HX711

The HX711 load cell amplifier is used to get measurable data from a load cell. The HX711 is 24-bit analog-to-digital converter (ADC) designed for weight measurement and industrial applications to connect with a sensor. It is made for amplifying signals from cells and reporting them to another microcontroller. Here, the load cell's measurements which provide output in millivolts will be amplified and passed on to Arduino by hx711.

Fig. 3 Load Cell Sensor 24 Bit ADC-HX711

D. Arduino UNO

Arduino board can read inputs like lights using sensor, a finger in a button sensor, a Twitter message and turn it into an output - activating a motor, turning on an LED, publishing something online. Arduino act as Controller[1].

Fig. 4 Arduino UNO

4. SIMULATION

The load cell sensor helps to detect the level of saline water easily. The buzzer alarm can be used to alert the observer when the saline bottle gets empty. When the bottle has filled no action is taken. When the saline water comes to the critical level, the level in which is saline water is going to get emptied, the buzzer alarm alerts the observer. When the bottle is filled, the first LED glows. When the saline bottle is partially filled, the second LED is illuminated and when the bottle gets emptied third LED glows.

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Table1: Different Levels with effects on Load cell sensor and actions are taken

Different Levels	Effect on Load Cell Sensor	Action Taken
Filled	500 ml	No Action Taken.
Partially Filled	200 ml	Alerted the observer using Buzzer Alarm.
Completely Empty	0 ml	Alerted to nurse and the saline bottle is changed.

5. SIMULATION RESULTS

The detected weights are continuously displayed in Arduino IDE, and the LED and buzzer alarm indications whenever the threshold level(<=300ml) is met. The weights are indicated in kg.

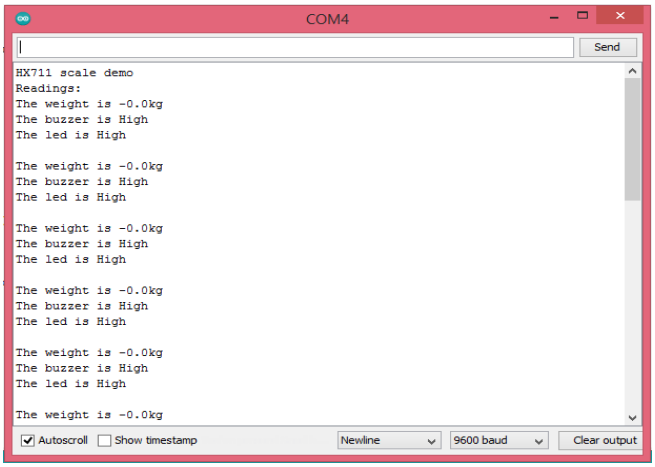

Fig. 5 Results of when no weight applied

6. EXPERIMENTAL SETUP

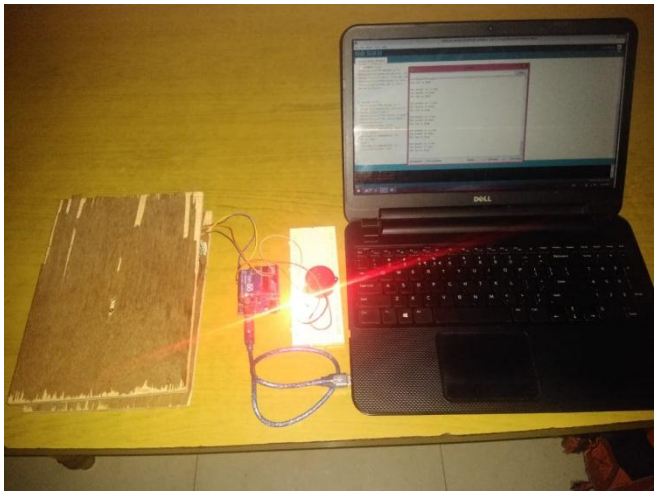

Fig. 6 Experimental Setup

7. CONCLUSION AND FUTURE WORK

By sending glucose bottle alerts to hospital staff, the constant need to manually monitor glucose level is avoided. It is of high advantage to the nurses and patients, especially during night times. This system also avoids the fatal risk of air bubbles entering the patient's bloodstream, which is a severe threat as air bubbles in the blood can cause immediate death. And this is easily implementable in all areas from common wards to intensive care units, making this easily accessible.

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