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Internet of Things Smart Intravenous Saline Bottle

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Abstract - The hospital staff and health workers are under tremendous pressure and fatigued is in pandemic situations. The present invention aims to obviate the scenario where the nurse has to recursively check if the fluid level is low or not. This invention is an integrated alert system for the Saline or Electrolyte bottle levels which the patients are subjected to. It uses a non-contact capacitive switch sensor to detect if the fluid falls below a predetermined level. The sensor interacts with a Wi-Fi intergraded micro-processor module sends a push notification in phone application. The system also has a buzzer which will be placed beside the patient's bed to alert someone if present in close proximity. This reduces nonproductive works and prevents medical accidents which occur if the saline or electrolyte bottle is not replaced or refilled on time.

Key Words: **Wi-Fi, Notification, Saline Bottle, Health, IOT, Bio-Medical**

1. INTRODUCTION

We stumbled upon this idea of Innovation upon realizing that there is need of continuously monitoring the fluid levels manually. But because of the busy schedule of the health care professional, they sometimes forget to change or refill the bottle on correct time. As a result of which the lives of the patients can be at risk because in such conditions air bubbles can enter the blood stream or the backflow of the blood can take place which can lead to the death of the patient. So, to improve health care system, eliminating the need of constantly monitoring the fluid level manually, this invention will be of great use.

The present invention relates to a small step towards building smarter health care services in our country. It is an alert system built for the Saline or Electrolyte level in the bottle which a patient is subjected to. It alerts the nurse with a push notification in phone application and also rings a buzzer near the patient's bed when the fluid level falls below a predetermined level. It obviates unnecessary checking of the fluid level by the nurse or attendant every now and then. It can be retro fitted on the bottle and uses a capacitive non-contact type switch sensor to perform the said function.

2. Working of the Invention

2.1 Detailed Description of the Invention

The following description relates to a particular manifestation of the present invention. The present invention comprises of four main parts mainly data acquisition, the microcontroller, wireless communication system and an alarm system.

Data acquisition relates to non-contact liquid level sensor (2) which is attached on the outer surface of the medical fluid delivery bottle (1). The sensor (2) makes use of the advanced signal processing technology to achieve the non-contact fluid level detection. The sensor (2) is used to continuously monitor the level of the fluid present in the bottle (1). The sensor (2) provides a very accurate and stable output when the level of the liquid exceeds a certain threshold level.

The analogue to digital converter is used in the system to receive the analogue signal of the fluid level detected from the sensor (2) and to convert it into a digital value which is then given to the microcontroller (3).

The microcontroller (3)[1] receives the digital signal indicating the fluid level present in the bottle (1). The microcontroller (3) also compares the signal value with a threshold level simultaneously. So, when the sensor's value falls below the pre-set threshold level, the microcontroller (3) will provide signal, to the buzzer (7).

Saline bottle (1) will be containing the fluid or electrolyte which is supposed to be given to the patient. The liquid level sensor (2) will be attached to this saline bottle (2) to indicate the level and notify via phone application when it goes below a certain limit.

Non-contact liquid level sensor (2) is connected to saline bottle for continuously monitoring the level of fluid. Its working principle is based on variation of capacitance depending upon the water/ liquid. In the absence of liquid near the sensor, there will be a presence of distributed capacitance, and therefore there are some certain static capacitance to ground on the sensor (2). As the amount of liquid increases gradually close to the sensor (2), the parasitic capacitance of the liquid will be coupled to the static capacitance so that the final capacitance value of the sensor (2) becomes larger and the changed capacitance

signal is then input to the control IC for signal conversion, then converting the varied capacitance into the amount of change in the electrical signal. Lastly, by using a certain algorithm the degree of this variation can be determined when the amount of change exceeds a certain threshold which means the liquid level to reach the induction point. When fluid is above a present level it will continue to generate a HIGH signal and a red light.

On detection of liquid level below a present level, capacitance will vary and the red light will get turned off. D1 MINI (3) will be connected to this sensor (2) which will receive an analog signal according to variation of capacitance.

D1 MINI (3) is connected to non-contact liquid level sensor (2) which will receive analog signal depending upon the variation of capacitance. This analog signal will be converted to digital signal by this D1 MINI (3) and it will be processed further.

D1 MINI (3) is a mini Wi-Fi board based on ESP8266EX. This board is Arduino IDE compatible; therefore, it can be programmed using Arduino or its own Lau compiler.

When liquid is available it will continue receiving a HIGH signal and as soon as it receives a LOW signal, D1 MINI (3) will notify on the receiving device connected to it. Also the buzzer (7) is connected to D1 MINI (3), which receive signal to generate alert by buzzing.

Switch (4) is used to turn the system on/off, so when it is not in used battery won't get discharged uselessly. Battery (5) can be in the range of 500 to 3000mA[2]. It is of high energy density and voltage. It provides long stable power with flat discharge voltage. Charging circuit (6) the tp4056 is a complete constant-current/constant-voltage linear charger for single cell lithium-ion batteries. Its SOP package and low external component count make the tp4056 ideally suited for portable 10 applications. Furthermore, the tp4056 can work within USB and wall adapter. It is used to charge the battery (5). Buzzer (7) is connected to D1 MINI (3). It will receive signal to give a buzzing alert.

In another embodiment, the D1 mini NodeMCU Wifi development board (3) uses inbuilt ESP-8266EX micro controller (3a) and has a 4MB flash memory and has a clock speed of 80/160 Mhz and the wifi works on 2.4GHz as well as 5GHz frequency band.

In another embodiment, the capacitive switch sensor (2) is retro fitted on the saline bottle (1) with the help of a sensor mount (11) and a resizable elastic band (10) and is connected to the micro controller unit. In another embodiment, the capacitive switch sensor (2) is a non-contact type 35 fluid level sensor (2) switch which works on an input voltage range 5 – 24 Volts and consumes a current of about 5mA.

In one embodiment, a alert system comprising of D1 Mini NodeMCU Wifi Development Board (3); a capacitive switch sensor (2); an ESP-8266EX micro controller (3a); a rechargeable compact lithium ion battery (5); a charging circuit (6); and a buzzer (7); wherein D1 Mini development Board (3) monitors 20 the signal input from the capacitive switch sensor (2) with the help of ESP8266EX micro controller (3a) and sends a push notification to the registered account on any device when the fluid level in the saline bottle (1) is below predetermined level.

In another embodiment, the compact and rechargeable lithium ion battery (5) has a capacity from 300 mAH to 5000 mAH which provides on board power supply to the system. 5 In another embodiment, the charging circuit (6) is a complete constant current/constant-voltage linear charger for lithium-ion batteries (5). It has 4.2V charge voltage, and the charge current can be programmed externally with a single resistor. 10 In another embodiment, the charging circuit (6) to facilitate the charging of lithium ion battery (5) from wall socket and prevent overcharging of the battery (5). In another embodiment, the buzzer (7) is connected to the micro controller (3a) 15 and buzzes to give a primary indication along the bedside with a sound alert and it operates at a sound pressure level of 95 dB volts and at a frequency of 3900±500Hz.

2.2 Arduino R3 Code[3]

```
#define BLYNK_PRINT Serial

#include <ESP8266WiFi.h>

#include <BlynkSimpleEsp8266.h>

BlynkTimer timer;

const int buzzer = 12;

char auth[] = "xxxxx"; //Replace xxxxx with the authentication code

char ssid[] = "yyyyy"; //Replace yyyyy with WIFI SSID

char pass[] = "zzzzz"; //Replace zzzzz with WIFI Password

int flag=0;

void notifyOnButtonPress()

{

  int isButtonPressed = digitalRead(D1);
```

```
 if (isButtonPressed==1 && flag==0){
 digitalWrite(buzzer, HIGH);
 delay(1000);
 digitalWrite(buzzer, LOW);
 delay(1000);
}
else{
 digitalWrite(buzzer, LOW);
}
 if (isButtonPressed==1 && flag==0) {
   Serial.println("Saline bottle will empty soon");
   Blynk.notify("Low Fluid level at Room No. xx Ward No. yy");
   flag=1;
 }
 else if (isButtonPressed==0)
 {
   flag=0;
 }
}
void setup()
{
Serial.begin(9600);
Blynk.begin(auth, ssid, pass);
pinMode(D1,INPUT_PULLUP);
pinMode(buzzer, OUTPUT);
timer.setInterval(1000L,notifyOnButtonPress);
}
void loop(){
 Blynk.run();
 timer.run();}
```

3. Description of Drawings:

Figure 1 shows the block diagram of the present invention.

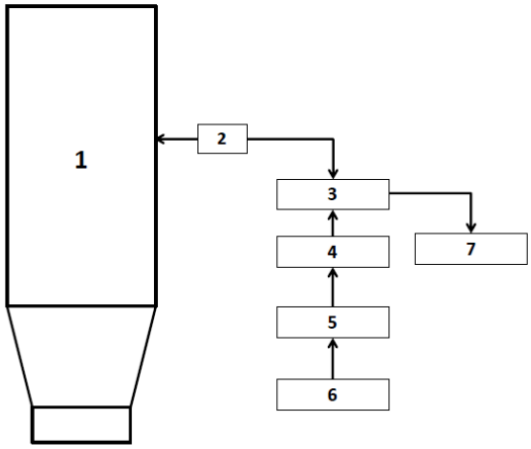

Figure 1

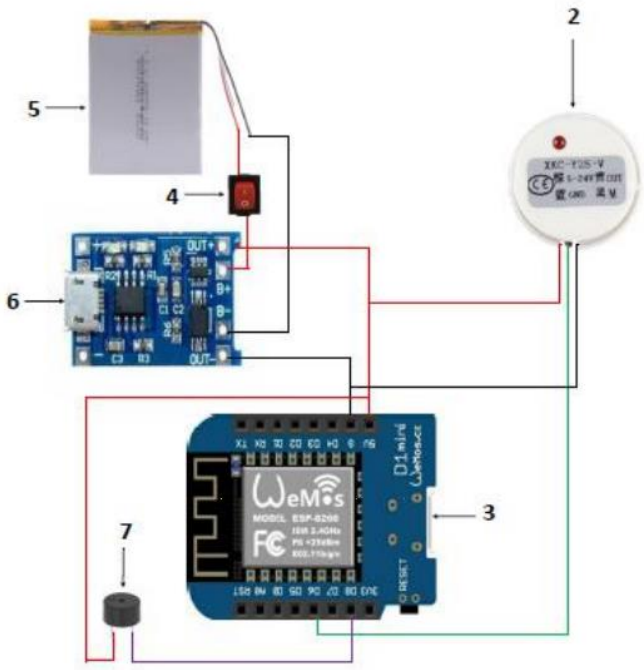

Figure 2

Figure 2 shows the circuit connections of the present invention.

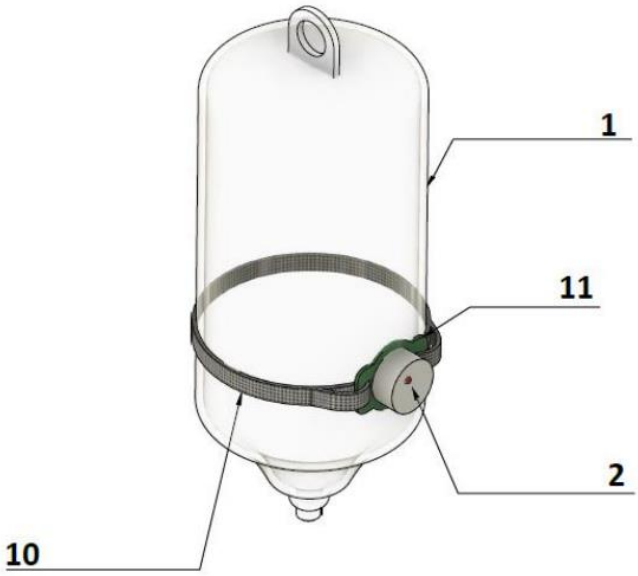

Figure 3

Figure 3 shows the isometric representative diagram of the present invention.

4. CONCLUSION

This invention will very helpful to medical staff and avoid the medical accidents in the hospital.it is very low cost product so it is economical in term of money with very accurate and good quality component. This reduces nonproductive works and prevents medical accidents which occur if the saline or electrolyte bottle is not replaced or refilled on time.

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