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IoT Based Smart Bottle Sensor for Health Care

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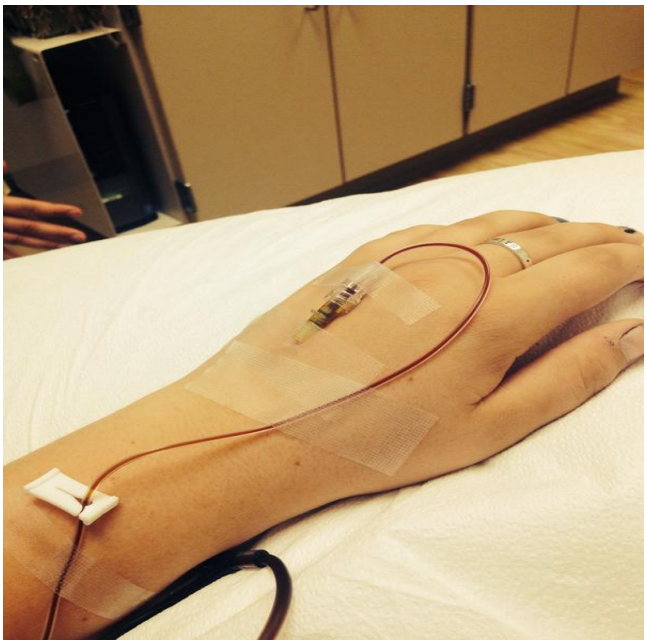
Abstract: ***Electrolyte bottle monitoring has become difficult due to tight schedules most especially during these pandemic times that have left health workers with little or no time. Improper monitoring of electrolyte bottles can result into serious life-threatening risks. We intend to design a reusable electrolyte level sensor using Ultrasonic sensor and Arduino Nano. The project will have a transmitter circuit that will use Rf communication to send the data to receiver circuit for processing. The transmitter circuit has an ultrasonic sensor that will be used to measure the distance of electrolyte level in bottle. The data is then sent wirelessly to the receiver circuit where percentage of the electrolyte level is shown on LCD module. If it shows 100% electrolyte consumed, then an alarm is sent off alerting the health worker in charge. It is also our aim to develop an electrolyte level detector that is reusable, efficient and most importantly affordable for health care industries. Building such a monitoring system, will reduce patient hazards and also improve health care service delivery in terms of accuracy. Health care workers will not need to constantly or manually assess the level of electrolyte left in the bottle most especially during night shifts. Air particles or bubbles can enter the patient's blood stream if electrolyte bottle gets empty and still attached to patient. If these particles enter, it can result into immediate death. With further developments, it can be upgraded to send message to a doctor/nurse's phone, along with the patient's room number and other specifications.***

Keywords – Alarm, Arduino, Electrolyte Transmitter, Receiver, RF communication, Ultrasonic sensor.

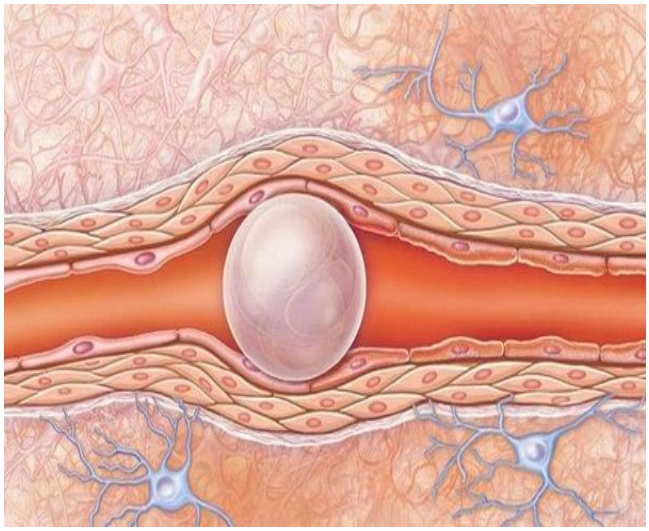
I. INTRODUCTION

In recent years, there has been a lot of technical and non-technical advancements or improvements in the health care industry to ensure fast and efficient recovery of patients. In order to achieve this, proper IV level management and assessment is needed. In almost all hospitals, a nurse or health worker is responsible for checking if Intra-Venous (IV) Bottle is empty or not. But unfortunately, due to busy schedules, health workers may forget or become too occupied to revisit and check electrolyte level on time. Failure to change or remove the electrolyte bottle on time will result into air particles going into the patient's blood system, leading to immediate death. In addition, there may also be backflow of blood towards the electrolyte bottle. This system can help send out an alarm in case the electrolyte level is fully consumed. This system can be applicable in all department of hospital ranging from Small to Large Hospitals and even go as far as being used in Home care.



[Fig 1. Backflow of blood into IV Tube]

If the electrolyte bottle becomes empty and is still attached to patient body (through injection to the vein), air bubbles can enter the blood system leading to immediate death.



[Fig 2. Image of Air Particle in blood vessel]

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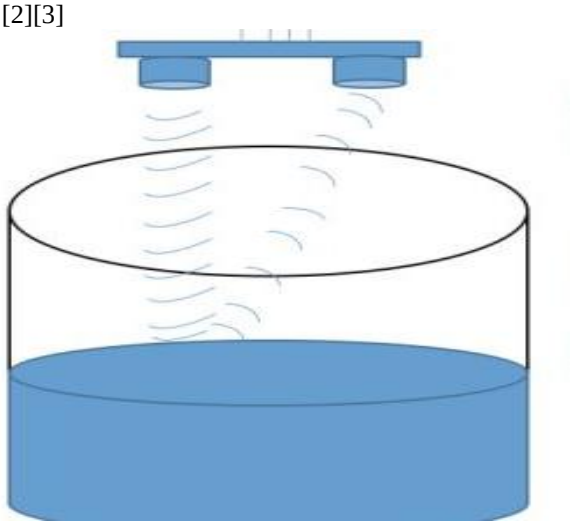
II. SYSTEM CONFIGURATION

In this project, we will use a receiver circuit that will consist of mainly a 16x2 LCD, Buzzer, Arduino Nano and RF receiver module that will enable RF communication with Transmitter circuit. Transmitter circuit will consist of Ultrasonic Sensor, RF Transmitter module and Arduino Nano. The Ultrasonic sensor will be used to measure the electrolyte level and send the data to the Receiver circuit via the transmitter module. The data sent is then processed and shown on LCD as percentage.

The system will be able send out an alarm when the electrolyte level is fully consumed.

A. *Working Principle of Ultrasonic Sensor*

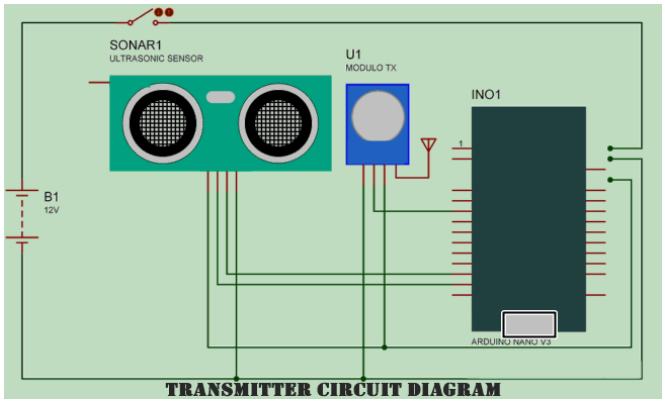
The ultrasonic sensor is built with two metallic petri-dish like openings. The two openings are Trigger and Echo. The Trigger opening is responsible for sending high frequency sound waves that bounce back after hitting the surface of electrolyte inside the bottle. The sound waves that have bounced back are then received by Echo Opening which send the data to Arduino Nano to later be sent to Receiver Circuit via RF Transmitter Module. The time it takes for the sound waves to bounce back will help us tell how much distance is travelled by electrolyte in the bottle thus telling us electrolyte level. [2][3]



[Fig 3. Working of Ultrasonic Sensor]

B. *Transmitter Circuit of an IoT Based Smart Bottle Sensor for Health Care*

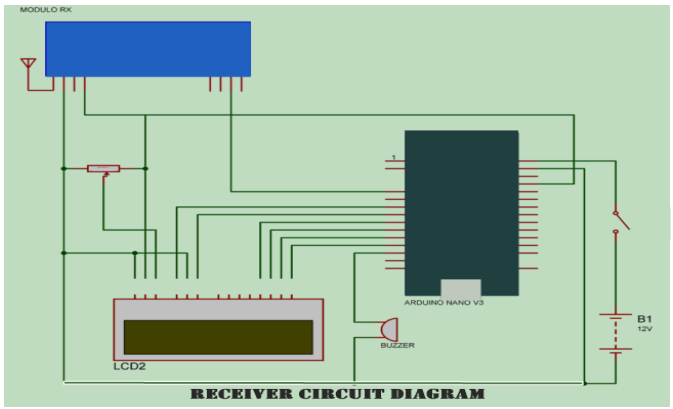
While building the transmitter circuit, we used an Ultrasonic sensor, Arduino Nano and Rf Transmitter Module. We were able to integrate the four pin Ultrasonic sensor with Arduino Nano by connecting Trigger and Echo pins to D9 and D10 respectively. The remaining pins of Ultrasonic sensor are Vcc pin for Power Supply and Ground pin for connecting to Ground. The data got or assessed by Ultrasonic sensor is taken to Arduino Nano which transfers it to RF through D4. The RF Transmitter module has four pins which includes one data pin, one antenna pin and two power pins (Vcc and Ground). With this Rf Transmitter module, Antenna can be attached to increase distance of communication with Receiver Circuit. The circuit will require a 5v supply to work but 9v is advisable for efficient functioning. [1][2][3][8]



[Fig. Transmitter Circuit of IoT Based Smart Bottle for Health Care]

C. *Receiver Circuit of an IoT Based Smart Bottle Sensor for Health Care*

We were able to make this circuit by using a 16X2 LCD, Arduino Nano, Buzzer and Rf Receiver Module. The 16x2 LCD has 16 pins where Vss and Rw are connected to 5v, Vee is connected to 10k preset in order to control contrast on LCD, LEDA is connected to Vcc on Arduino Nano, LEDK is connected to 5v Power supply. Rs, E, D4, D5, D6, D7, D8 and D9 are connected from D4 to D9 of Arduino Nano respectively. Data is received from RF Receiver module and sent to Arduino Nano through pin D2. If the LCD shows "ELECTROLYTE CONSUMERD 100%", an alarm will go off to alert the health worker. The buzzer is connected to D10 of the Arduino Nano.[1][3][4][8]



[Fig. Receiver Circuit of IoT Based Smart Bottle for Health Care]

III. HARDWARE COMPONENTS

A. *Arduino Nano*

Arduino Nano is a type of Arduino board that is quite small in size which helps us to achieve our miniaturization target but also the cheapest Arduino board on the market keeping the production cost low. The Arduino Nano has a total of 30 pins, these includes 14 Digital pins for sending and receiving Digital information, 8 Analog Pins for sending and receiving Analog information, 2 Reset Pins and 6 Power pins (Vin, 2 Ground Pins, 5v Pin and 3.3v Pin).

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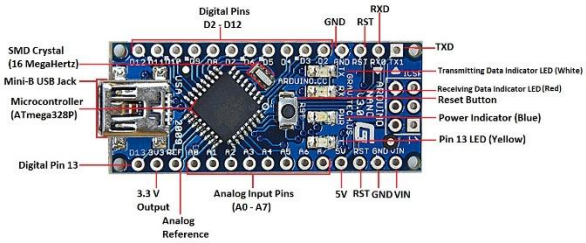
The Arduino Nano has same processor (ATmega328P) and connectivity options as Arduino UNO.[1]



[Fig. Arduino Nano]

B. ULTRASONIC SENSOR HC-SR04

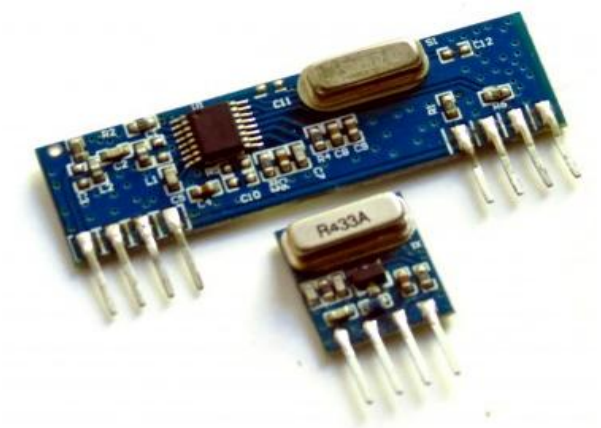
The ultrasonic sensor will be used in the Transmitter Circuit to measure the electrolyte level in the bottle. It has two petri-dish shaped metal opening with small tiny wire mesh at both ends. The Transmitter Opening sends high frequency soundwaves that bounce back after hitting the electrolyte. The echoed soundwaves are received by the Echo Opening. The time it takes for the soundwaves to bounce back is directly proportional to distance travelled by electrolyte. This helps us assess the electrolyte level.[2]

[Fig. Ultrasonic Sensor]

C. *RF TRANSMITTER RECEIVER PAIR ASK 433*

We were able to design communication circuits at both the Receiver and Transmitter Circuit. We used RF Transmitter Receiver Pair ASK 433 to achieve this. The RF Transmitter Module is a bit smaller compared to the RF Receiver Module that is rectangular in shape and has more pins. It generally depends on Radio Frequencies to send data across circuits. This particular design of RF Transmitter Receiver Pair uses a frequency of 433/434 MHz. In addition, it is quite affordable and its power consumption is also low making it ideal for this project.[3][8]

This RF Transmitter Receiver Pair ASK (Amplitude Shift Keying) 433 is able to communicate over a distance of 100 to 200 meters without attachment of Antenna but can be increased up to 500 meters with help of Antenna. This makes it quite ideal for the project in the sense that it can be used in Small, Medium and Large Hospitals without limitations.[3][9]



[Fig. RF Receiver and Transmitter Pair ASK 433]

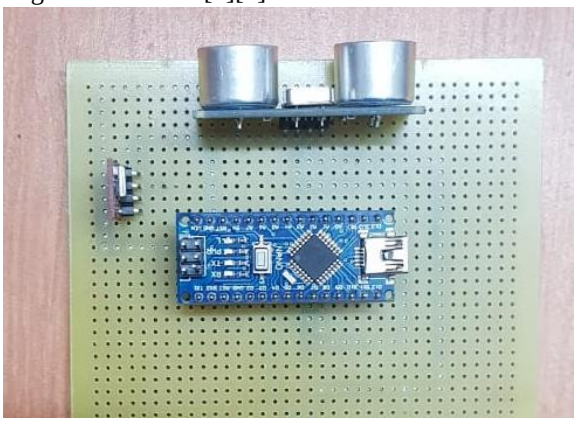
D. 16 X 2 LCD DISPLAY

We used a 16x2 LCD Display to show electrolyte in form of percentage. LCD stands for Liquid Crystal Display. It uses Liquid Crystal has its primary form of operating and it called 16x2 because on the display, there are 16 Columns and 2 Rows. A 16x2 LCD has 16 pins. These include: Vss, Vdd, Vee, Rs, Rw, E, D0, D1, D2, D3, D4, D5, D6, D7, LEDA, LEDK respectively.[4][7]

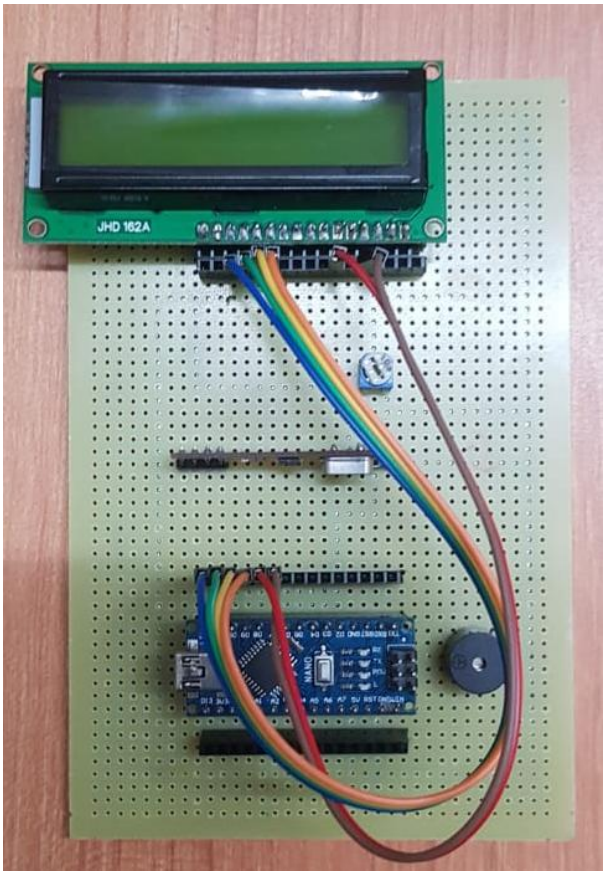
[Fig. 16 x 2 LCD Display]

IV. RESULT

The IoT Based Smart Bottle Sensor thus developed will be able send out an alarm when the electrolyte is 100% fully consumed. It is affordable, reusable and very easy to operate. We are also advancing our project to make reading more accurate and also more customer friendly like changing to rechargeable batteries.[5][7]



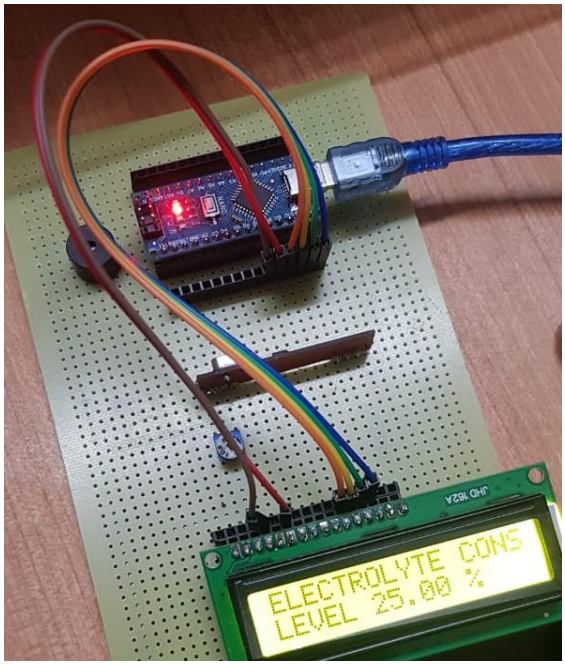
[Fig. Completed Physical Transmitter Circuit of IoT Based Smart Bottle Sensor]



[Fig. Completed Physical Receiver Circuit of IoT Based Smart Bottle Sensor]

V. WORKING OF CIRCUIT

[Fig. Placement and Working of Physical Transmitter Circuit of IoT Based Smart Bottle Sensor]



[Fig. Working of Physical Transmitter Circuit of IoT Based Smart Bottle Sensor]

VI. CONCLUSION

We were able to develop an electrolyte level detector/sensor that is reusable, efficient and most importantly affordable for health care industries. It will indicate amount of electrolyte in bottle as percentage on a 16×2 LCD module and also send out an alarm if the electrolyte level is fully consumed.

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REFERENCES

1. Working Principle of Arduino and using it as a tool for study and research, Leo Louis, Vol 1, No.2, April 2016.
2. Water Level Detection System Based on Ultrasonic Sensors HC-SRO4 and ESP8266-1 2 Modules with Telegram and Buzzer communication Media, Hanan, Anak Agung Ngurah Gunawan, Made Sumadiyasa, Vol.18, No3, 25th May 2019
3. 433 MHZ (WIRLESS RF) Communication Between Two Arduino Uno, Fahmida Ahmed, Shakh Md. Alimuzjaman Alim, MD. Shafiqul Islam, anti Bhusan Roy Kawshik, Shafiul Islam, Vol 5, ISSUE-10, PP 358-362,2016.
4. Interfacing to an LCD screen using an Arduino, Matt Clary, 4th March 2015
5. What is the Big Deal with Miniaturization, Emily Warner, Issue 1, 14th June 2014
6. Flexible Batteries Ahead, Leiwen Jingchen, Jiliang, Hui-Mingcheng, Issue 1, PP 20-23, 1st January 2017.
7. Liquid Crystal Display Bright Future, Alfred Poor, Issue 1, 9th September 2011.
8. RF Transmitter and Receiver, Georgewill M. Onengiye, Ezeofor J. Chukwunazo, Volume 5, Issue 4, April 2016.
9. RF Based Home Automation System, Dennis Mwanza, 2011

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