2022

Smart Pre-Dialyzer Project

BIO-MEASUREMANTS II

MIDTERM PROJECT

Team 16

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Midterm Project

SMART PRE-DIALYZER

Team 16 | Bio-Measurements II | 8-5-2022

Hardware Components


Arduino Uno


Power Bank (power supply)


Wires


2 Color Sensors


Handmade Wooden Box


Pump


Wifi Module


10k Resistors


Water Level Detector Sensor


Ultrasonic Sensor


Water Proof Thermistor


Heater


2 Plastic Boxes


LDR Sensor

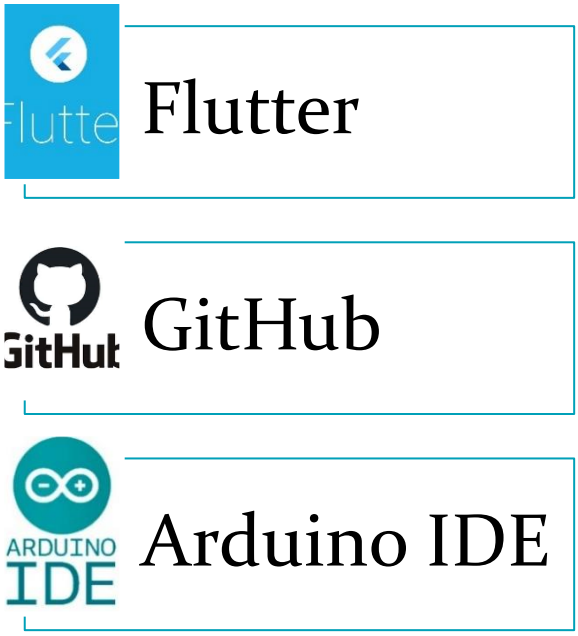

LEDs


2 Relays


Plastic Pipe


PH Strip

Apps and online services



GitHub Repo's Link: https://github.com/Zeyad-Amr/Akwa-Dialysis

Introduction

As known about Hemodialysis process consists of

1. Dialyzer.
2. Blood Circuit.
3. Dialysate Circuit.

It is required to Start Hemodialysis process Prepare the environmental conditions to Dialysate which are:

1. PH Range: 6.8 - 7.6
2. Temperature: 35-42˚C
3. Conductivity: 12–16mS/cm
4. Dialysate flow rate: 0.5 – 0.8 L/min

Application Description

"**Smart Pre-Dialyzer**" is a monitored dialysate circuit using **mobile application and Web Site**.

"**Smart Pre-Dialyzer**" simulates Dialysate Circuit and its Alarm and Monitoring systems.

- Dialysate Circuit: By pumping the dialysate into a pipe.
- Alarm System: By handling conditions and LEDs.
- Monitoring System: By using mobile application.

The Process

1. Large Wooden Container: Provides:
   1.1. **Closed system** prevents heat transferring.
   1.2. **Portability**.
2. LDR Sensor: Controls the device's **power on\off**.
3. Dialysate Container:
   3.1. Ultrasonic sensor: Measures the **percentage filled** with dialysate in the container.
   3.2. Thermistor: Measures the **temperature** to send a feedback about the required range **(35-42˚C)** to let the pump take an action.
   3.3. Heater: Provides the **temperature range required**.
   3.4. PH Meter paper: Its color changes according **media's PH**.

3.5. Color Sensor of the dialysate container: Tests the color of the PH Meter paper to **calculate the PH** (6.8-7.6) as a **trigger to switch the pump on**.

3.6. The Pump: Controls the process after the power is on.

4. The Pipe: Provide **pathway** of the fluid (dialysate).
5. Color Sensor on the pathway: To detect the **blood leakage** which if it Detects blood, the pump stops the flow.
6. Drain Container:
   6.1. Water Level Detector: **A monitor and an alarm** of the container to know whether the container is about to be filled or not.

Solved Problems

In dialysate circuit, the **Smart Pre-Dialyzer** solves:

1. Dialysate level monitor. (First Problem)
2. Drain level alarm. (Second Problem)
3. Blood leakage detector. (Third Problem)
4. Figure out the PH value using color sensor. (Fourth Problem)

Why the solutions are important

- 1st Solved Problem: Dialysate level monitor is important to know if the container has dialysate or **not to start the cycle with no loss in power according to pump work**.
- 2nd Solved Problem: Drain level alarm is important to know whenever the container need to be drained in order not to overflow.
- 3rd Solved Problem: Blood Leakage detector is very important to be tested along the cycle because it is a critical point to occur leakage in blood along the circuit which requires **stopping the process**.
- 4th Solved Problem: PH Sensor is **an expensive Sensor**, figure out a way to measure by using **PH Meter paper and a color sensor** and **not all machines has PH monitor**.

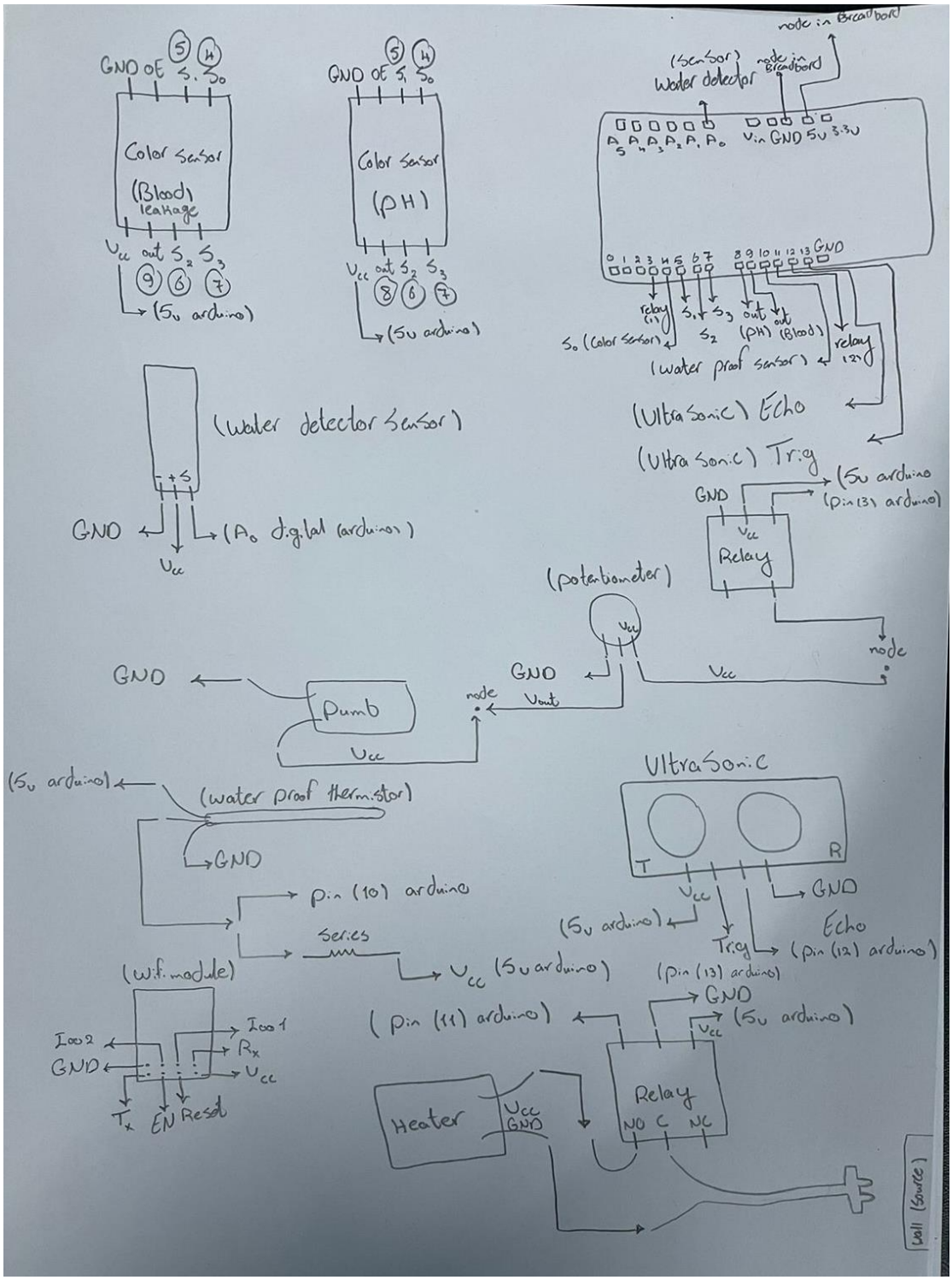
Assumptions

- Assumed that the conductivity is adjusted because the measuring difficulties. 12–16mS/cm
- Flow is adjusted as the required value. 0.5 – 0.8 L/min
- Dialysate container must be fully filled to provide suitable level to let the heater start heating.

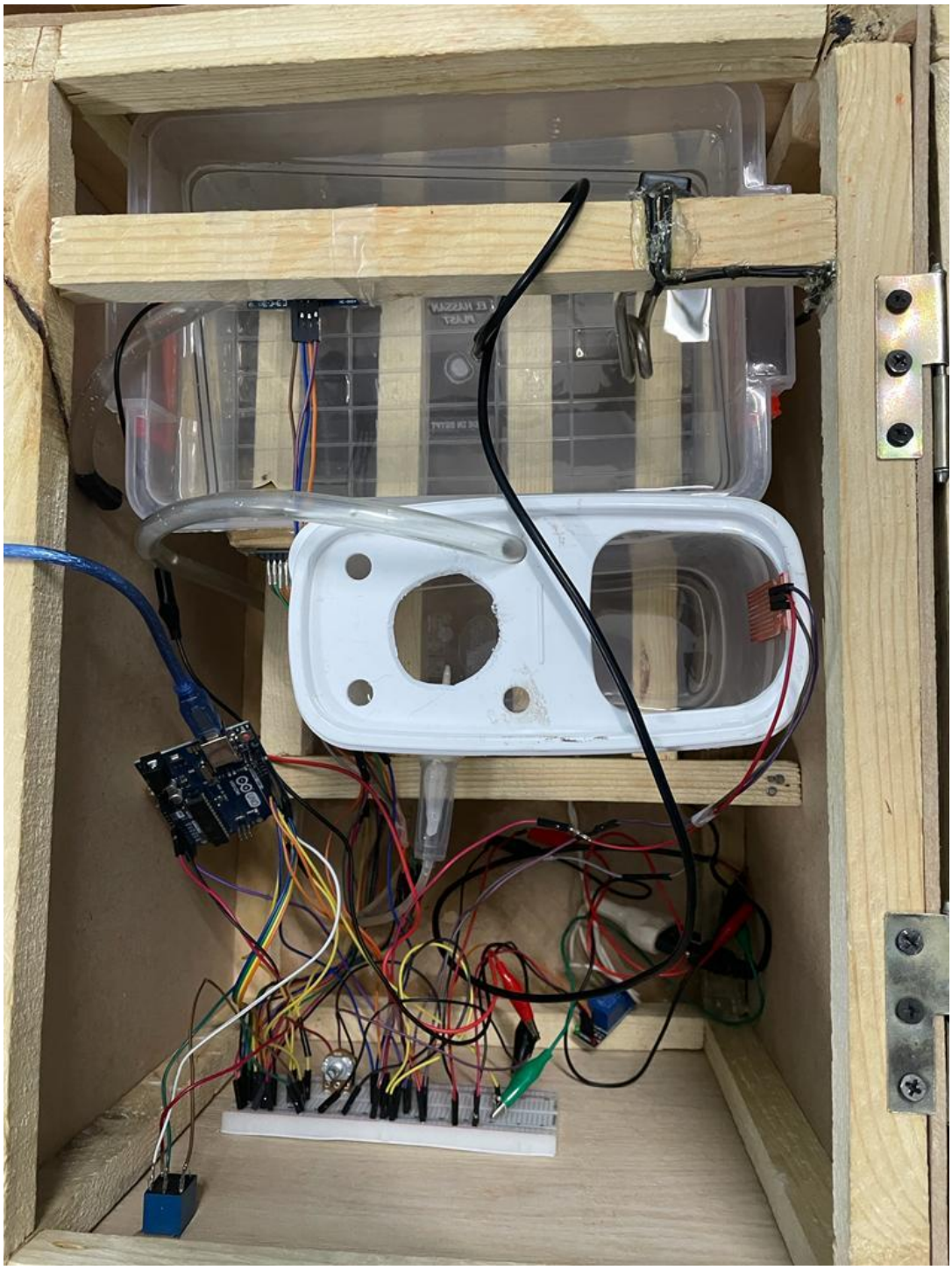
Dialysate Formulation

Electrolyte	Concentration
Potassium	0-4 meq/L
Sodium	134–145 meq/L
Calcium	0.0–3.5 meq/L (2.25 standard)
Chloride	100–124 meq/L
Magnesium	0.5–1.0 meq/L
Glucose	0–250 mg/dL
Bicarbonate	32–40 meq/L

Schematic diagram of the electronic circuit



Snapshot of prototype



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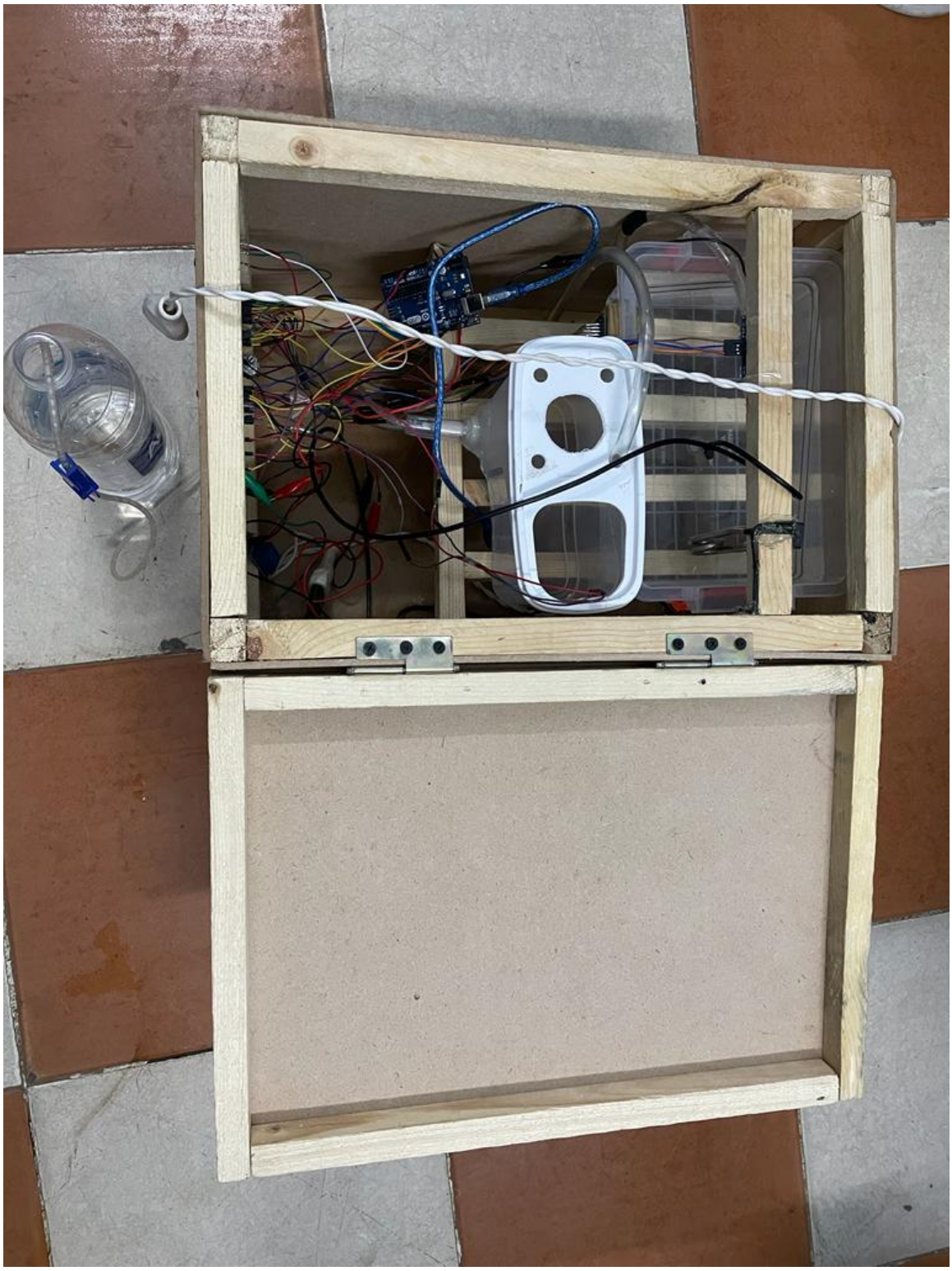
Circuit-Top-View

Side-View



Top-View