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ChloraCam

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BIOMEDICAL ENGINEERING

ChloraCam

CAPSTONE DESIGN EXPO 2017

BME 113 | **Team members:** Aayushi Agarwal, Nathaniel Brigle, Ramya Nandigam, Zachary Siou | **Faculty adviser:** Dr. Daniel Conway, Ph.D. | **Sponsor:** Dr. Todd Gehr, MD

Introduction

The current method for testing water quality at hemodialysis centers is prone to negligence and falsification. Developing a better method of testing will eliminate these liabilities and improve patient safety.

Figure 1. Dialysis Water Filtration Tanks

Project Objective

The objective is to minimize the liability associated with the current testing system; this will be done by developing a device capable of automatically reading and recording test strips and an integrated alarm system to notify nurses when testing is required.

Design Requirements

- Reminder alarm and display system for chloramine measurements
- Automated reading of the test strips
- Quantification of the chloramine concentration
- Storage database for recorded data

Current Method

Figure 2. Serim© Colorimetric Test Strips

Preliminary Design

This design works in conjunction with the current system used. It requires the user to insert the colorimetric test strip into a box in a controlled environment. Computer image analysis is then used to read the results and determine the color of the strip. A computer data logging system will record the test result. Lastly, an alarm will be used to remind nurses when testing needs to be done.

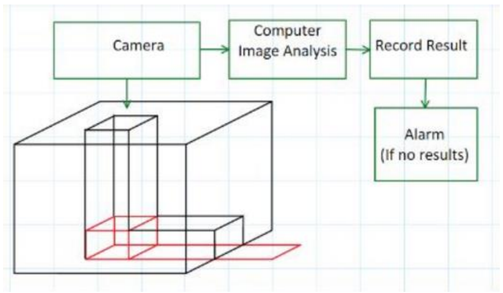

Figure 3. Schematic of Preliminary Design

Testing Environment

We determined the infill percentage, weighing printing time vs. minimization of water leakage. However, we decided waterproofing spray was more effective in removing the holes while retaining structural integrity.

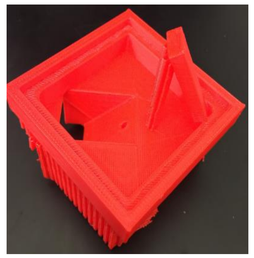

Figure 4. Preliminary Prints of Testing Environment

We determined the tolerances for insertion of the PVC pipe to the containment chamber by measuring the outer diameter of the PVC connector and printing holes with differing diameters of +/- 0.5 mm increments. Another method for connecting the PVC involved a cone-shaped pressure fit. The base of the fit has larger than the inner diameter of the PVC, thus forming a pressure fit connection. However this method was not able to form a secure connection.

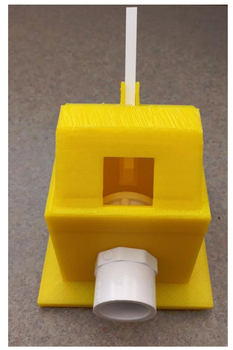

Figure 5. Final Print of Testing Environment

Raspberry Pi Software

We developed a MATLAB code as a way to verify the results of the Python code. The MATLAB code could read any picture and output the average R, G, and B values. Python coding involved code that would read an image and output its RGB color values. These values are then compared to a baseline. We also determined how to copy these values onto a text file; this data is automatically saved into the database.

```
from PIL import Image
im= Image.open("BMEStiny.png")

pix= im.load()
print im.size
im.convert('RGB')
#10, 7
x= 0
y= 0

while True:
    print pix[x,y]
    x+= 1

    if x== 10:
        y+= 1
        x= 0
        print("RGB VALUES")

if y==7:
    break
```

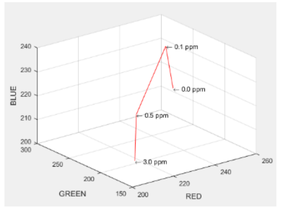

Figure 6. Preliminary Code (Left) and Graph of RGB Values (Right)

Future Directions

In the future, we plan on creating a visual alarm to supplement the auditory signal for elevated concentration levels. We also plan to fully automate the entire testing process; currently we have automated the sampling through the implementation of the solenoid valve system. In the future, we would also like to automate inserting the test strips and running the software code. Lastly, we are planning to market the device. This will entail further market analysis research to assess our prototype's commercial viability, sustainability, and manufacturability.

Acknowledgements

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