

Creating a Bioluminescence Detector

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INTRODUCTION

The navy is looking for a way to make transportation at night more effective and efficient by increasing the amount of visibility. When merchant marines are transporting goods at night they're basically dependent on technology to guide them, meaning they're traveling blind. They run into problems like storms that disrupt their technology. But there is something called bioluminescence, it emits light from a living organism. This is potentially a solution for this problem because it increases the amount of vision that the mariners will have at deep levels.

Bioluminescence is a light that is produced by living organisms, like algae, fireflies, and jellyfish. The fireflies use bioluminescence to communicate. The angler fish have bacteria that are bioluminescent and they use this to lure fish to eat while jellyfish use it to scare off potential predators. Even though there are ways to detect this in a laboratory setting, like using luciferase assays, there's nothing for use in the field. But with the ability to detect luminescence, exploration of the deep sea will be more efficient, it will open new possibilities for explorers. That's why we are trying to make something that can be used in the real world, like on ships.

Will the substance of bioluminescence create a more efficient way for merchant marines? Our goal is to create an inexpensive sensor that can be used to detect bioluminescence underwater. This is valuable because it can help with understanding and exploring the deep ocean. We are using a photodiode to detect the light and using the arduino to read the sensor. Also, we are using a filter to make sure the only light we are detecting is in the range of 450nm- 490 nm, which is the same wavelength in which bioluminescence occurs.

METHODS

1. Learning Arduino
2. Writing Arduino code
3. Pick and order parts
4. Building prototype on Fritzing
5. Writing Arduino Code
6. Building Prototype
7. Testing Prototype
8. Refining Prototype

FUTURE PLANS

9. Waterproofing Sensor
10. Testing Waterproofing
11. Testing Sensor Underwater

ARDUINO CODE

```
int sensorPin = A2;
int sensorValue = 0;
const int high = 15; //set high parameter
const int low = 5; //set low parameter

void setup(void) {
  pinMode(A2, INPUT); //sensor
  pinMode(2, OUTPUT); //red
  pinMode(3, OUTPUT); //yellow
  pinMode(4, OUTPUT); //green
  Serial.begin(9600);
  pinMode(sensorPin, INPUT);
}

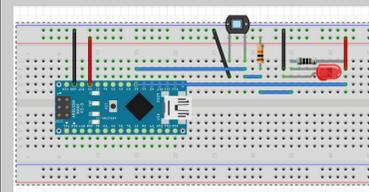
void loop(void) {
  sensorValue = analogRead(sensorPin);
  float lightLevel = (sensorValue) * 5.0; //amplifying signal

  Serial.print("Light Level: ");
  Serial.println(lightLevel);

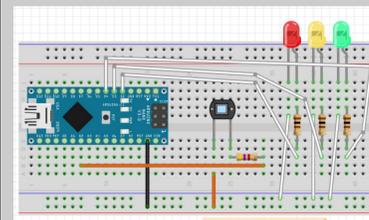
  if (lightLevel < low) { //low, red light on
    digitalWrite(2, HIGH);
    digitalWrite(3, LOW);
    digitalWrite(4, LOW);
    Serial.println(" No Bioluminescence");
  }
  else if (lightLevel >= high) { //high, green light on
    digitalWrite(2, LOW);
    digitalWrite(3, HIGH);
    digitalWrite(4, HIGH);
    Serial.println(" Bioluminescence");
  }
  else { //medium, yellow light on
    digitalWrite(2, LOW);
    digitalWrite(3, HIGH);
    digitalWrite(4, LOW);
    Serial.println("Low Bioluminescence");
  }
  delay(10);
}
```

Arduino: 1.8.11 (Windows 8.1), Board: "Arduino Nano, ATmega328P"

PROTOTYPES

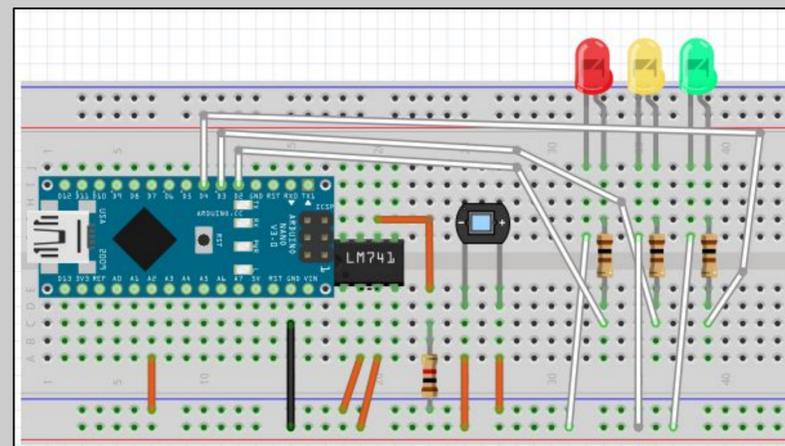


Model 1. A previous model of the breadboard



Model 2. A previous model of the breadboard

DESIGN



Model 3. Our final, functional model.



DISCUSSION

Prior to this project, we had never used arduino before. We faced some difficulties in the beginning figuring out how arduinos worked, and learning about the different parts that they have. To solve this problem we had to do a lot of background research and playing around with the arduino pieces and the code. Only once we were familiar with the equipment could we start to figure out a way to create a prototype diagram. In the process of testing the models of the bioluminescent detector, we came across the problem of installing the arduino software into the computer to be able to communicate the code that we wrote to the arduino in order to give its function. After a whole afternoon of coming up with solutions we finally successfully ran the arduino software. After it was connected, the photodiode wouldn't pick up the laser light in range of 450nm- 490nm that we were testing to simulate a real life bioluminescence. We searched for what might be wrong and we discovered that we had to lower the "Low" light setting from 5 to 0.5 and the high from 15 to 1.5. That is equivalent to a ten-fold decrease and now it is able to read the light range of the laser. In the future testing the bioluminescent detector underwater would be the biggest priority to get a more accurate result of the detector and its function on the environment that it would be use for an see if its function improved or not. Our project would be a great asset to anybody that would like to use our technology for better.

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