

## Utilizing Color Sensors and Urinary Collection Bags as a Warning System for Hematuria

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Gross hematuria, a condition where there is visible blood in the urine, is a serious symptom of severe illnesses that, if not treated or taken to surgery as quickly as possible, can have detrimental effects on individuals, including death. As an indicator of various diseases, such as bladder or kidney cancer, inflammation in the urinary tract, blood-clotting disorders, and more, it is crucial for doctors to be notified immediately if there is any blood found in the urine. This is why I created my project - a urine bag that detects a color change in the urine and buzzes to notify doctors that there is something wrong with a patient. It is essentially a warning system for hematuria and will accelerate the timeline for diagnosis of the condition. The quicker the diagnosis of hematuria, the quicker the diagnosis of the potentially more severe conditions causing it. If my project is able to detect hematuria immediately, the faster the more serious conditions can get diagnosed and treated.

The objective of my project is to successfully create a warning system that identifies a red color in urine collection bags and notifies medical professionals of this with a buzzing sound. My plan is to design, manufacture, and test a urine bag with an attached color sensor that can send an alert when the color changes from a clear/yellow color to a pink/red color. The designing process will begin by installing the Arduino Development System, enabling me to develop a program for the Arduino Nano. I will then attach a TCS34725 Color Sensor and a piezo buzzer to a breakout board, using wires to connect the digital output pin to the pin on the color sensor and the buzzer to the pin on the Arduino Nano. I will then use a basic Python code for laptop communication with the Arduino Nano that I had researched and found online for a different device with a "color sensor to sound" system (Elektor). The successful performance of my project would be the color sensor detecting a red/pink color in the urine bag, causing a buzzer to sound with 262 Hz for a set length of time.

As I began to assemble my project, there were no risks or safety precautions that had to be taken, other than being careful when working with the wiring on the breakout board. Each round of design, manufacturing, and testing brought light to new errors and enabled me to improve the design. Rapidly testing and making alterations to the code and wiring system were the keys to improving my project. In terms of my results, the code seemed to run properly, and the color sensor was able to detect when the water turned from clear to red. I tested this by placing regular tap water into the urine collection bag with the color sensor attached, and after no reaction from the sensor, I proceeded to add 3-4 drops of red food coloring to resemble traces of blood in the urine. The color sensor was successful in detecting this color change.

Unfortunately, my project was unsuccessful overall in achieving its full objective. While I was able to achieve the color sensor part to detect traces of blood, I was unable to perfect the communication system, where the buzzer is activated when the color sensor detects red. This was the main goal for my project - to create a warning system. This was not achieved in my device, but I do believe that with more time and work on the Nano and code, I will be able to create a fully-functioning warning system for hematuria.