History

The development of fluorescence detector

The detection device is divided into four generations according to the measurement method used, and different detection heads are used. The four measuring heads of the device are shown in the figure below. On the right of the single chip from left to right are the photoresistor module, silicon optical battery and amplifier circuit, photosensitive diode module and photosensitive diode circuit.

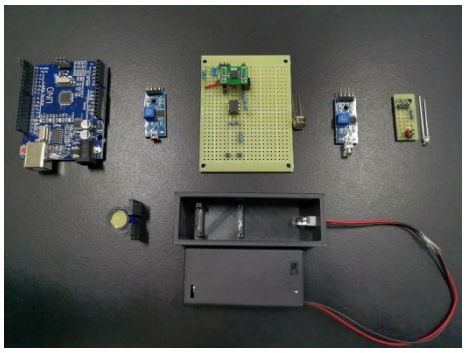

Figure 1. Experimental device and four detection heads.

The general experimental evaluation results of each generation device are shown in the table below.

Device	Detector	Sensitivity	Stability	Complexity	Reproduce
1.0	photosensitive resistance module	high	low	low	easy
2.0	silicon photocell and amplifier circuit	low	high	high	hard
3.0	photodiode module	middle	high	low	easy
4.0	photodiode circuit	high	high	low	easy

Table 1. The general experimental evaluation results.

The following is the detailed experimental and iterative process of the device:

This is our detection device 1.0, which uses the photosensitive resistance module to connect the microcontroller to detect fluorescence, and the circuit is directly powered by the microcontroller. After excitation, the fluorescence signal passes through the filter and is detected by the photosensitive resistor module. The photosensitive resistance module has high sensitivity, but it is very unstable. The detection value of the same stable fluorescence signal has been changing greatly, and there is no way to obtain a relatively clear measurement value in the actual measurement, so it is abandoned.

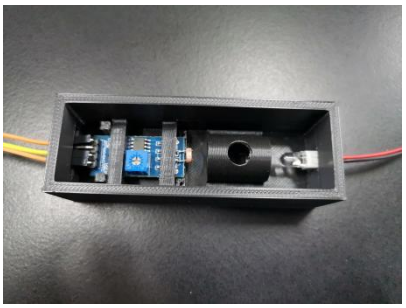

Figure 2. Device of photosensitive resistance module.

This is our detection device 2.0, which uses silicon photocell and amplifier circuit to measure fluorescence and convert it into voltage through silicon photocell. The conversion voltage of silicon photocell is relatively stable, but the range of change is very small, so we use the amplifier circuit to amplify it and then use MCU to detect. However, as the input voltage of single-chip detection is limited to less than 5V, the fluorescence intensity detected by us is relatively strong, but the accuracy distinction is required to be high, so many conventional high-amplification modules cannot be used. We also made amplification circuits using LM358 with OPA2353.However, the actual measurement of the basic amplifier circuit will be greatly disturbed, and the hardware performance can not meet the requirements. And the amplification circuit with high accuracy is too complicated to achieve. Finally, after a lot of experiments and improvements, we still abandoned the scheme.

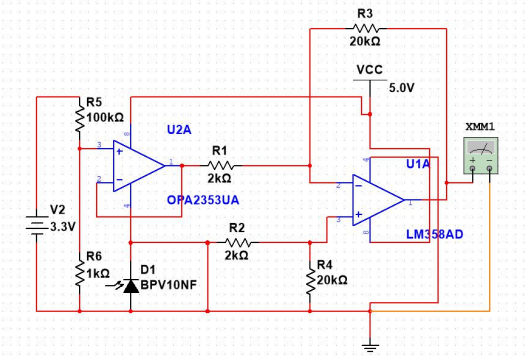

Figure 3. Circuit diagram of the amplifier circuit.

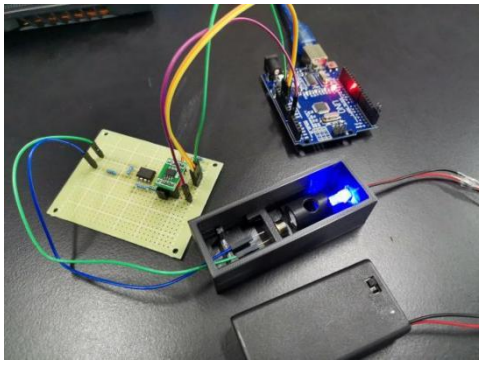

Figure 4. Device of silicon photocell and amplifier circuit.

This is our detection device 3.0, using a photodiode module. The stability of photosensitive diode module is close to that of silicon photocell, and the detection sensitivity is improved based on silicon photocell. However, the sensitivity of the module is still too small to meet the need to distinguish between different intensities of fluorescence. Finally, the module was abandoned, but it also provided ideas for the formation of our final circuit.

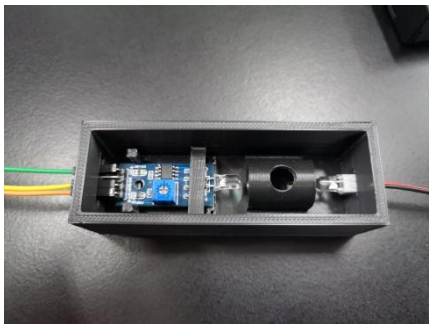

Figure 5. Device of photodiode module.

This is our detection device 4.0, which is the photodiode circuit we design and improve now. The original photodiode module circuit also has the function of having high and low level output at the DO port. There are many components in the module, but the sensitivity is relatively limited. The current designed photosensitive diode circuit has simplified and optimized the structure, which is very simple, with only a few elements, which is very easy to reproduce. And now the circuit will adjust the sensitivity to 200 times that of the original module, the sensitivity is extremely high, but with high sensitivity and stable indication, it can meet the needs of our measurement.

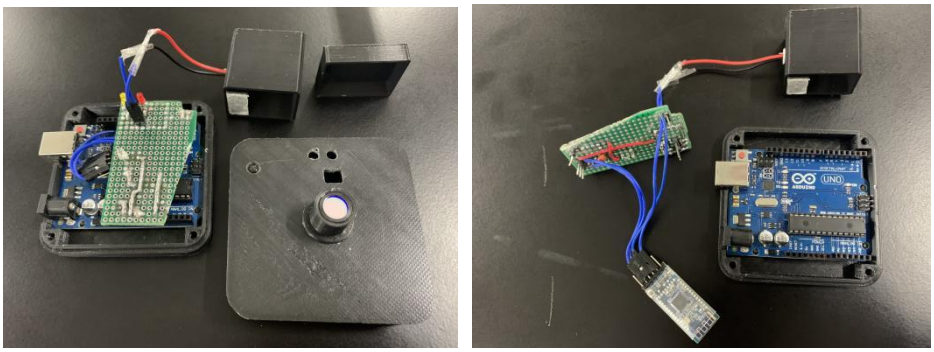

Figure 6. Device of photodiode circuit.