Making the QRB-1134 Photoreflector Quickconnect Cable

This document illustrates how to add a quick connect cable to the Fairchild QRB-1134 Photoreflective sensor.

Purpose: Why do this? The QRB-1134 sensor comes from the manufacturer with 4 long wires and no connector. The sensor will not stand alone as it is. Without a way to power the sensor and connect it to some device to read the output, it is useless. You could wrap the wires around posts or solder the wires directly, but this makes the sensor permanent and moving to another project is inconvenient.

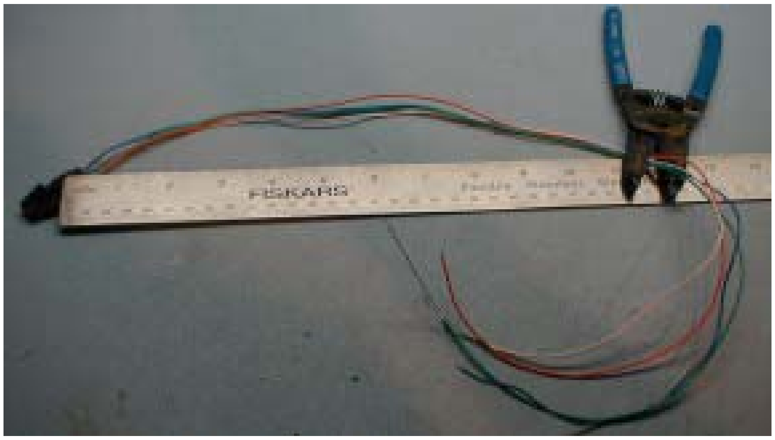
You must add 2 resistors to power it and get output, and in order to plug it into the DARC Board you as well must add a 3 pin connector. This 3 pin connection is convenient on other robotics boards as well.

A quick tutorial on how the sensor works once you have made the modifications to it follows at end of this document.

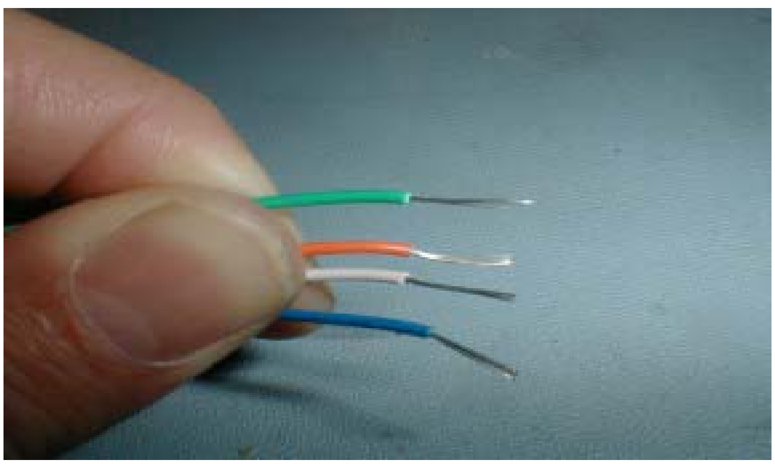
Parts needed: As shown below you will need

- Soldering iron
- Electrical tape or heat shrink tubing
- Wire strippers
- 1 QRB-1134 sensor
- 1 10 K-ohm resistor (brown, black, orange stripes)
- 1 100 ohm resistor (brown, black, brown stripes)
- 3 pin connector with wires (preferably black, red, yellow). Order of the wires in the connector are ground, power, signal (power must be in pin 2 position). You could get this connector out of an old computer, etc.

1. Cut the wires of the QRB-1134 to a length that is good for your application. For most DARC Board apps, about 12 inches is a good safe length that will be manageable.



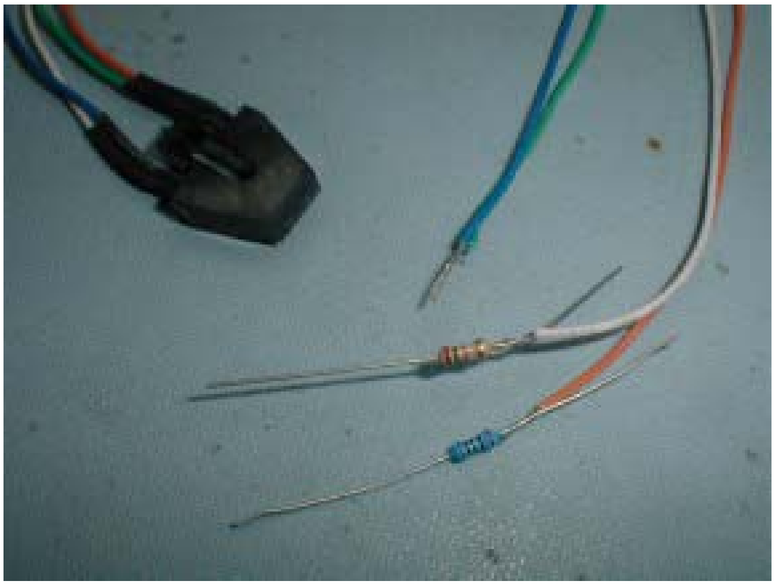
2. Strip all four wires so that about 1/2" of wire is exposed.



3. Twist the blue and green wires together and solder them.

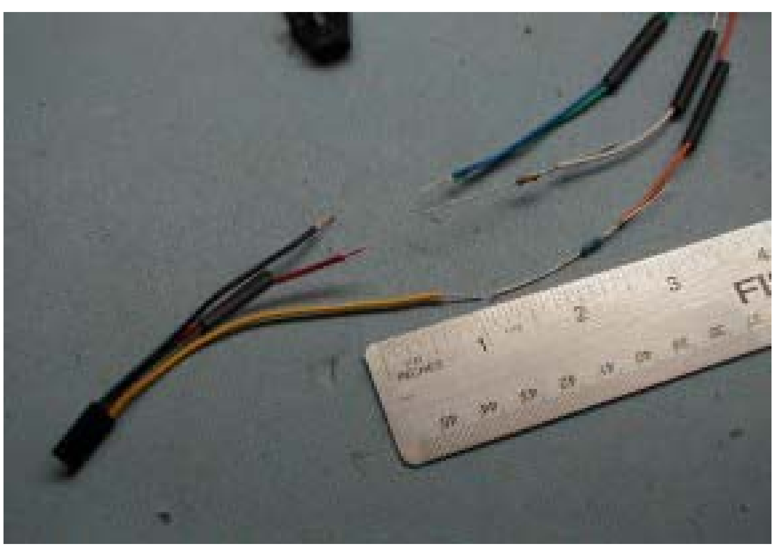
4. Twist the white wire onto the 10K (brown, black, orange stripes) resistor. The wire should be tight against the resistor body. **Do not trim resistor leads.**

5. Twist the orange wire onto the 100 ohm (brown, black, brown) resistor. Again, tight against the resistor body. **Do not trim resistor leads.**

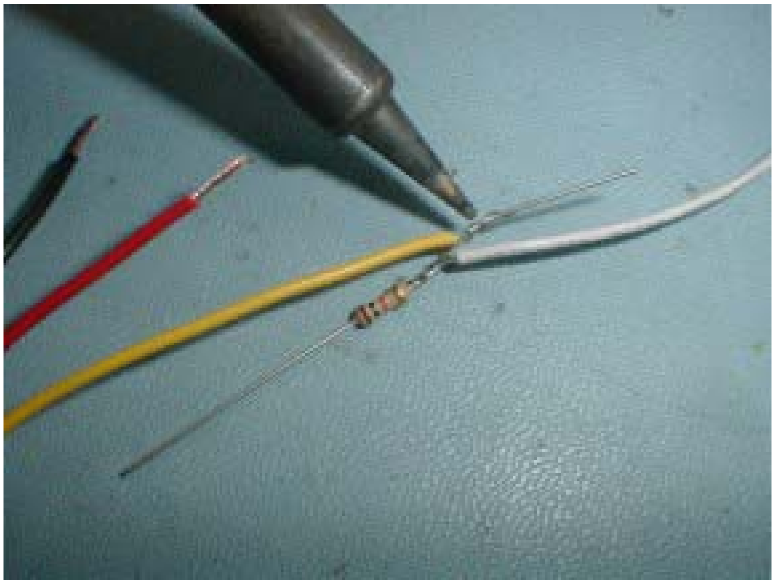


6. cut the wires of the 3 pin connector such that the signal wire (yellow in photo below) is about 1 inch longer than the power and ground wires (red, black here). The yellow wire should be about 3 inches long from the 3 pin connector. Strip the wires with about ½” of wire exposed.

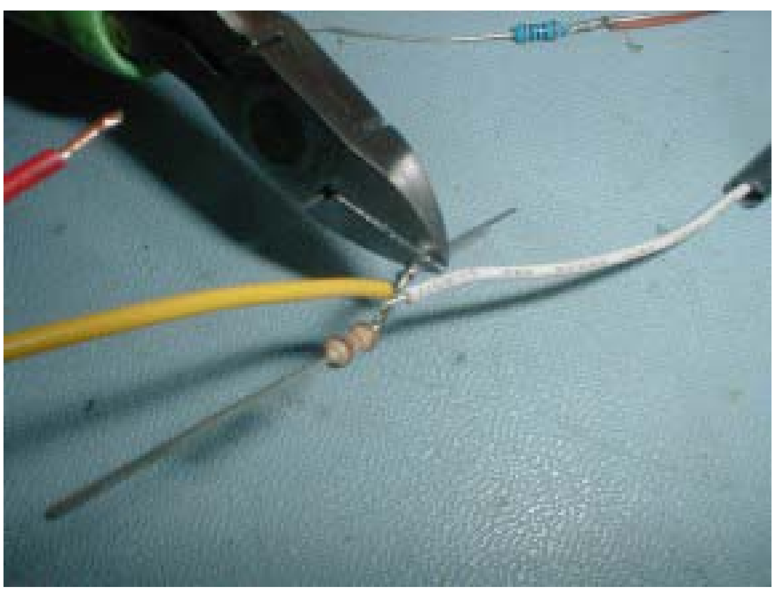
7. Place heat shrink tubing if used on each of the QRB-1134’s wires. Blue/Green are considered one wire at this point. If you are using electrical tape do nothing for now.



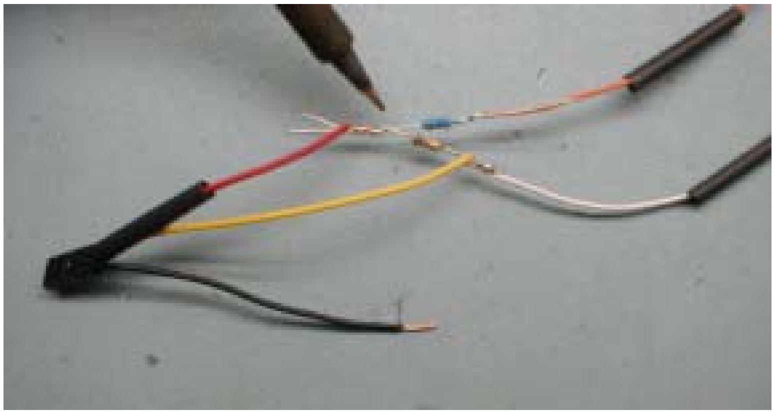
8. Wrap the signal (yellow in this photo) wire around the 10K resistor, which is attached to the white wire. The connection should be made so that the signal wire is tight to the resistor body. Solder this in place.



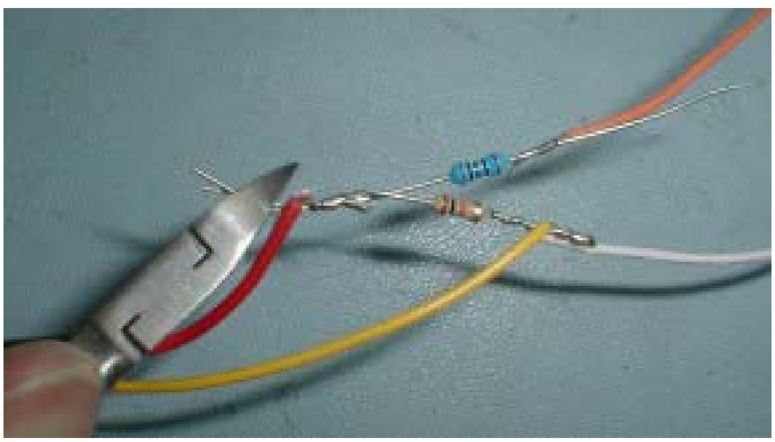
9. Trim the lead of the 10K resistor ONLY WHERE THE SIGNAL AND THE QRB-1134 WHITE WIRES COME TOGETHER.



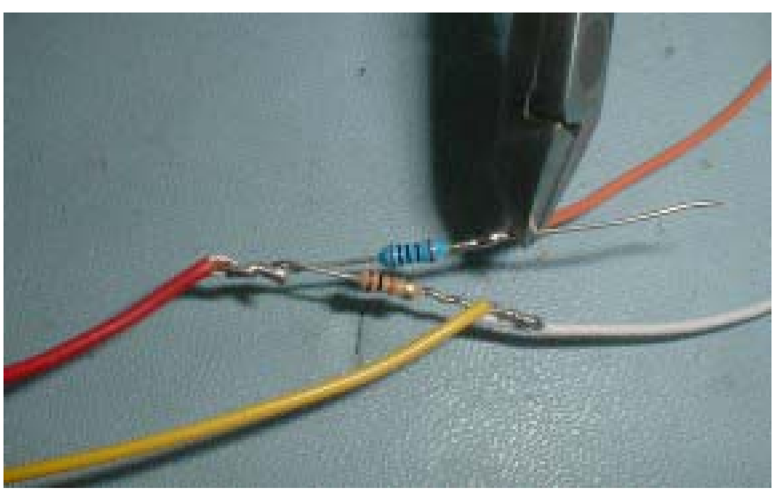
10. Twist together the leads of the 10K and 100 ohm resistors, then twist the power (middle wire of 3 pin connector) around the leads. Solder all of this in place.



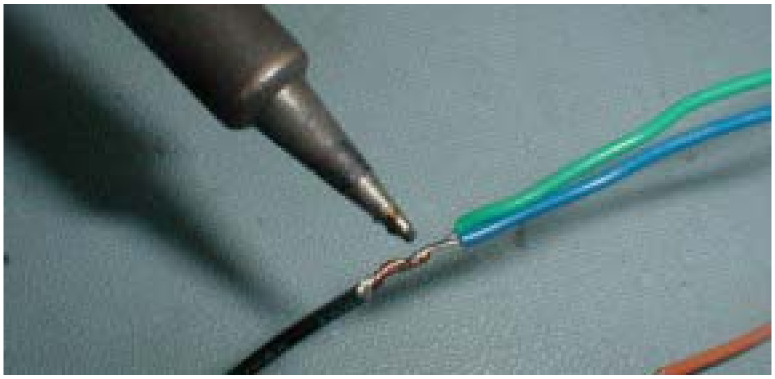
11. Trim the excess resistor lead wires that are connected at the 3 pin connector's power wire.



12. Trim the 100 ohm resistor lead at the point after the QRB-1134's orange wire has connected.

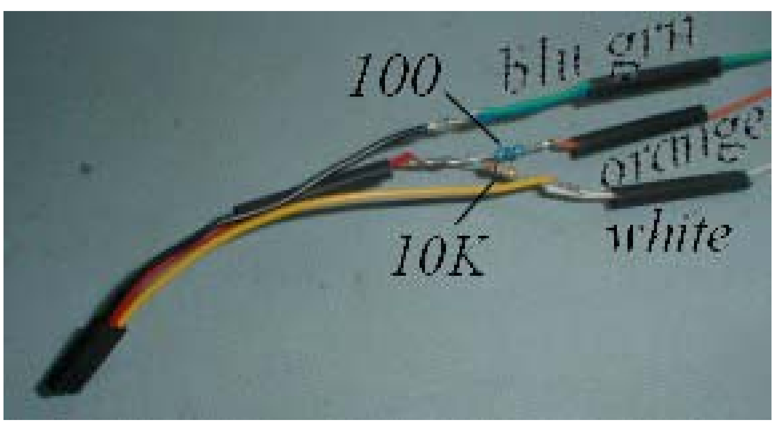


13. Wrap the 3 pin connector ground wire (black in this photo) around the blue/green wire of the sensor and solder.



14. Examine your work so far. It should look like what is shown below. The resistor has two sides, right and left in the photo below.

QRB wire	**connected to**
Blue/Green	3 pin connector ground wire (black)
Orange	to 100 ohm resistor right side. 100 ohm left side goes to 3 pin connector power (red) wire and also to 10 K resistor lead
White	To 10K resistor right side. 3 pin connector signal wire (yellow) also connects to white wire and 10K right side. Left side of 10K goes to the 100 ohm lead left side and also to 3 pin connector power wire (red).



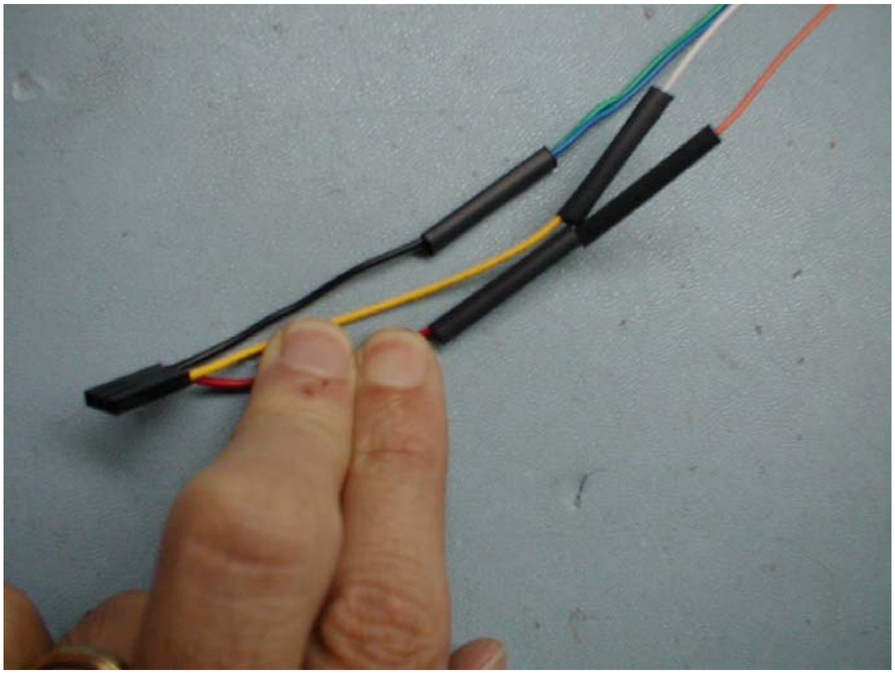
15. TEST YOUR WORK BEFORE WRAPPING OR HEAT SHRINKING THE WIRES. Here's how to test your work. See photos below.

Connect the 3 pin connector to the DARC Board Port A/D7 header. The ground wire goes at top of the board as shown and the signal (yellow) goes to inside closest to the Atmel chip. A multimeter test lead connects to PortA pin 7 which is wired to the A/D7 port. The multimeter ground test lead attaches to the ground test point just to the right of the A/D port.

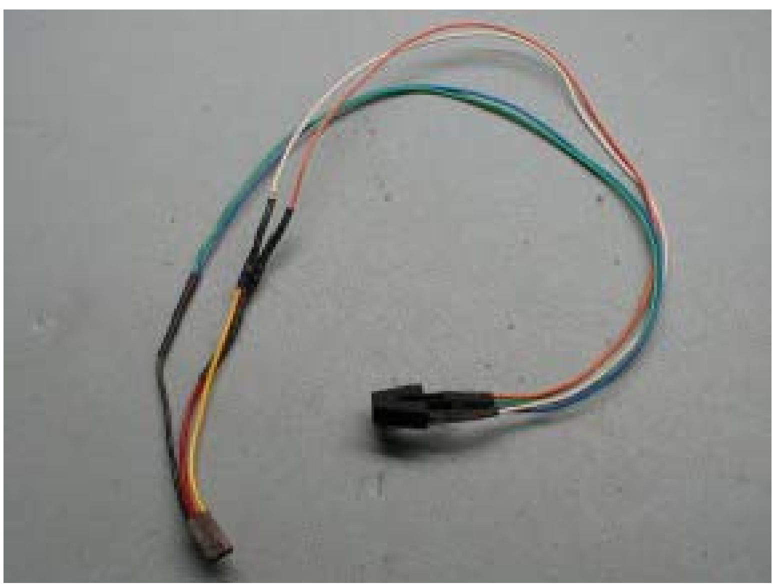
Set your multimeter for reading voltage, then power on the DARC Board. Move the QRB-1134 sensor over both white and black colored objects. Black electrical tape on white paper serves for this nicely. The black zone should give a voltage readout of 3-5 Volts DC depending on how closely you hold the sensor to the tape. Ideally the distance should be about ¼". On white, you should read nearly 0 Volts.

16. If you do not get the voltage readings as described, check your work. Be sure that the DARC Board is powerd on. Be sure that the 10K resistor goes to the white wire, 100 ohm goes to orange wire, etc. check all solder joints. Repair as necessary.

17. Finish by insulating the joints. If using heat shrink tubing, slide the tubing down over the joints and melt with heat gun. If using electrical tape, wrap tape around all of the joints. There should be 4 total pieces of tape or tubing.



The final product.



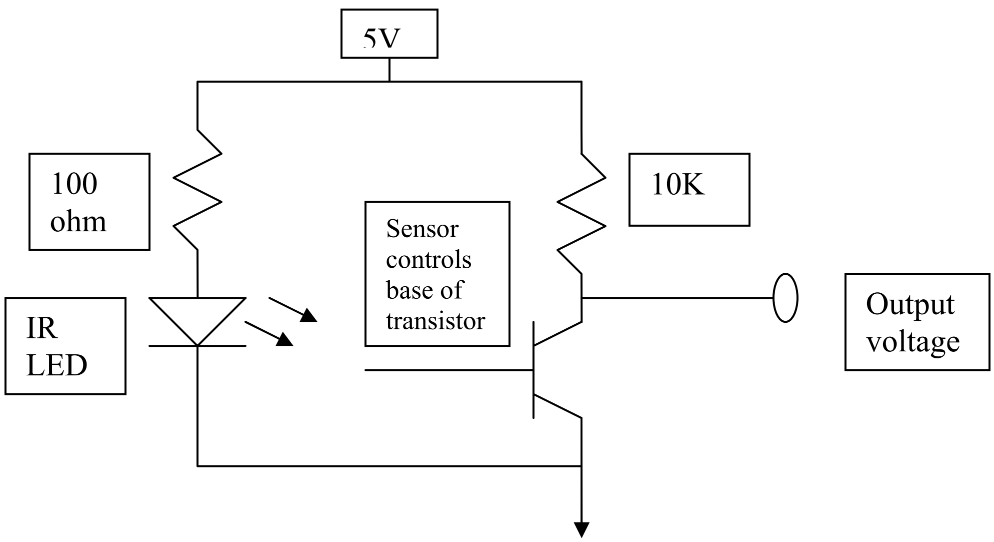
How does it work in the following section.

HOW DOES THE QRB-1134 SENSOR WORK?

The QRB-1134 is an I.R. photoreflective sensor. This means that it emits Infrared (IR) light from one side of the sensor at the head, and another part looks for how of that light is reflected back. If a reflective object (white painted object, your hand, etc) comes within the reflective distance (about 1 inch at most), then some light is reflected back and the sensor's output voltage will change. When no reflective object is present, then no light is reflected back and the sensor outputs 5V (or whatever voltage you power it with). Also a black object, even when it is very close will give an output near 5V. the reason for this is that black ABSORBS light and so little light is reflected off of it.

As a reflective object gets closer, the output voltage will slowly change from 5V to 0V. The actual measured voltages will vary, but typical outputs will be 4.5V for no object present or for a black object, and 1.5 – 2V when a reflective object is present.

The way that the sensor works is in two parts: emitter and sensor.



Emitter: On the left of the drawing is the emitter, an IR LED powered by the DARC Board or whatever is plugged into the 3 pin connector power pin (pin 2). The 100 ohm resistor is a current limiting resistor, which prevents too much power going through the LED and damaging it. The larger value resistor you put in here, the less light the LED will emit. So the value of this resistor will affect the range of the sensor for detecting reflection. Do not put larger than a 220 ohm resistor here or the range will be very small (1/2" or less). On the other hand, if you put in a smaller resistor, you risk burning up the LED.

Sensor: On the right is the sensor. The sensor is a phototransistor with the 10K resistor connecting its collector to 5V. The transistor will allow varying levels of current to flow through it depending on how much light enters the sensor. The sensor's detector plate is connected to the base of the transistor.

If no light hits the sensor, the transistor is switched off and the 10K resistor connected to 5V input pulls the output voltage to 5V. This is the black condition.

In white condition (lots of light hits sensor) the transistor is switched on, causing the output voltage point to be essentially connected to ground through the transistor's collector and emitter terminals, thus the output voltage is near 0V in the white condition.

In varying light levels, the transistor conducts varying levels of current, acting much like a voltage divider circuit where the transistor could be replaced by a variable resistor like a potentiometer.