HHZhang's writeup on the water sensor

Water level sensor detects the presence of environmental water around, such as sensing moisture, spotting leaks, detecting rainfall, or measuring water levels. The basic principle behind the water sensor is a variable voltage divider, which is composed of a pull-up resistor R_p of 1 MΩ, a series of 10 exposed parallel copper wires, 5 of which are power wires, and 5 are resistance wires. These traces are parallel to each other. Wherever water is detected, the moisture will bridge the power lines to the resistance lines. Since the water levels and droplet sizes are different, the parallel traces yield different resistance R_t. Then the voltage divider produces a voltage signal V_{out}, and it is sent to the analog inlet port of the Arduino UNO.

Obviously,
$V_{out} = 0$, when it is dry
The sensing signal is zero due to no current flows through the pull-up resistor R_p. When the water sensor senses the moisture, humility, rain droplet or water level, the sensing signal that is sent to the

analog input to the Arduino UNO is determined by the following equation:

$V_{out} = \frac{R_p}{R_p + R_t} V_s$, when it is wet

where $R_p = 1M\Omega$, V_s is voltage signal supplied from the Arduino UNO port, and

$$R_t = \frac{\prod_{i=1}^{5} C_{whi} R_i}{\sum_{j=1}^{5} \prod_{k=1}^{5} C_{whk} R_{k(k \neq j)}}$$

C_{whi} is the i^{th} constant that relates to the droplet with and height of the water. R_i is the varing resistance of the i^{th} resistor wire, that reflects the wetness.

The voltage input to analog input port is mapped from 10 bit data acquisition into 8 bit data for microcontroller operations.

For the water sensor, its working voltage is 5V+/- 0.25V, and current is 10mA-20mA, working temperature is 10 - 30oC, working humidity is 10% - 90%.