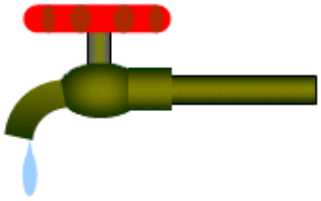
PROJECT: Water Detection



Level 2 - Exercises 1 to 5
Level 3 - Exercises 6 to 9

This project explores the electrical conduction characteristics of water, basic digital input and output logic, analogue measurement and information process.

This project incorporates the use of the PicPatch[08] microcontroller circuit board.

Materials: Cup of water and a dry sponge cloth to help produce variable moisture content.
Insulated hook up wire.

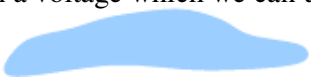
Objective:

As water is an electrical conductor we can detect and measure the level of moisture content present either on a surface or in porous material. This technology is used in many applications of which this project will explore just a few examples.

Scope:

Detection

Two electrical conductive plates or probes can be used to make electrical contact with moisture, which can simply be two copper wires. However for permanent applications a non corrosive metal such as stainless steel would be more suitable. If the two conductors are connected in a resistor divider network we can use Kirchhoff's first Law to obtain a voltage which we can use to measure the level of moisture.

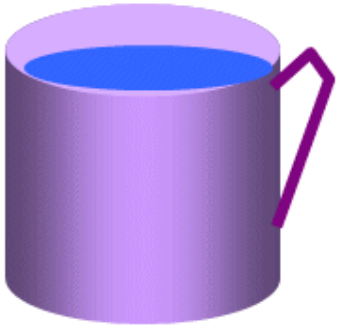


Indication

Sound can be used as a basic means to indicate the presence of moisture or water.
This can be done by making a Piezo beeper disk produce an audible tone.

Connection Diagrams

The microcontroller driver circuit requires the following components fitted onto the PicPatch[08] as illustrated in the water detection circuit diagram Figure 1.

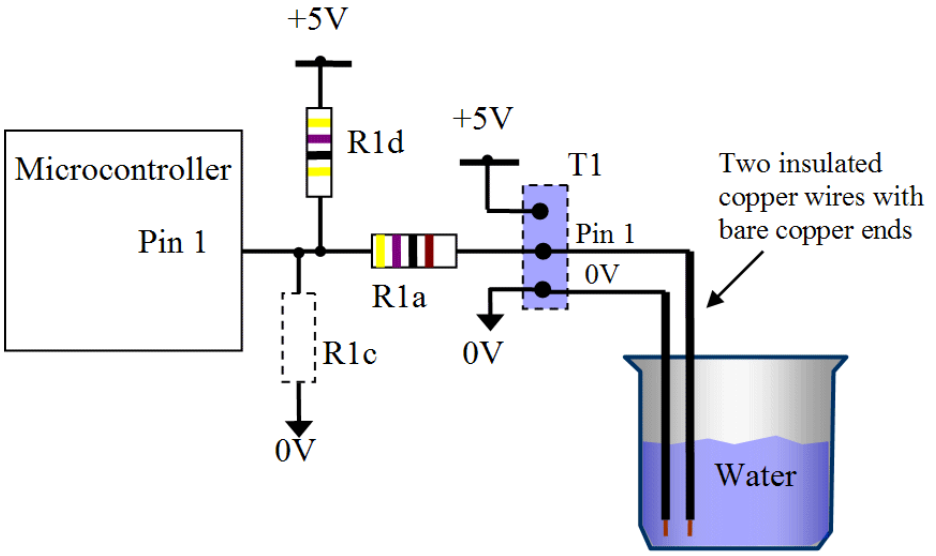


R1a = 4k7Ω (4.7k ohm) Resistor,
R1d = 4M7Ω (4.7M ohm) Resistor
(The pull-up resistor),
R1b and R1c leave vacant.

***Option.**
For a very long cable run fit a 10nF capacitor in place of R1c to minimise the effects of electrical noise interference.

Use two insulated copper wires with the copper ends exposed to detect the moisture.

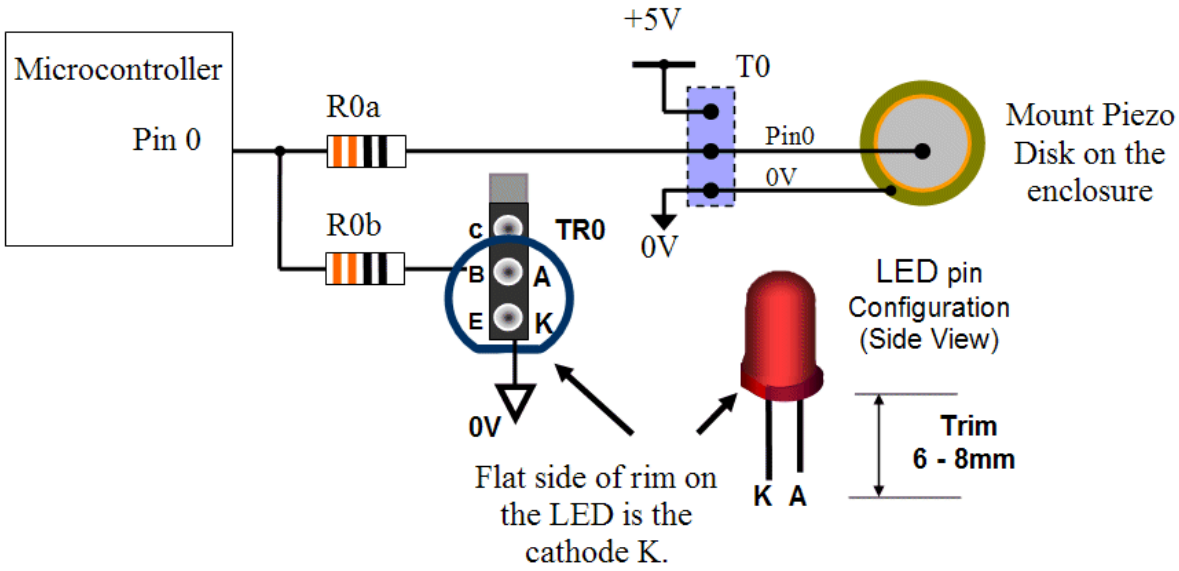
FIGURE 1. Water detection circuit.



The beeper circuit requires;

R4a = 330Ω Resistor,
R4b = 330Ω Resistor,
TR4 = Fit an LED into TR4 SIL Socket as illustrated.
The Piezo disk connects to T4 terminal Pin 4 and 0V as illustrated.
The Piezo beeper disk must be fixed on a firm surface for it to produce a sound.
You may wish to use double sided sticky tape or blue-tac.

FIGURE 2. Beeper driver circuit.



PROGRAM 1.

The basic "GO - NO GO" water test program.
The beeper will sound as soon as it detects water and the Led will flash.
Note you can also touch the probes with wet fingers to activate the beeper.

```
'Water detector program 1.
Input 1                         'Make Port Pin 1 an input
Loop:
      Pause 200                 'Wait 0.2 seconds
      If Pin1 = 0 then Beep     'If Pin 1 is pulled low by conduction then beep
      Goto Loop                 'or repeat the exercise
Beep:
      Sound 4, (110, 10)        'Make a tone on Port Pin 4
      Goto Loop                 'and repeat the exercise
```

Exercises for Level 2.

1. What practical applications could this project be used in a domestic appliance?
2. Present other ideas on how to indicate or demonstrate water being detected electronically?

PROGRAM 2.

This program reads an analogue level of conductivity,
the beeper will sound more frequently as more moisture is detected.
Use a sponge cloth with various degrees of moisture from dry to saturation.

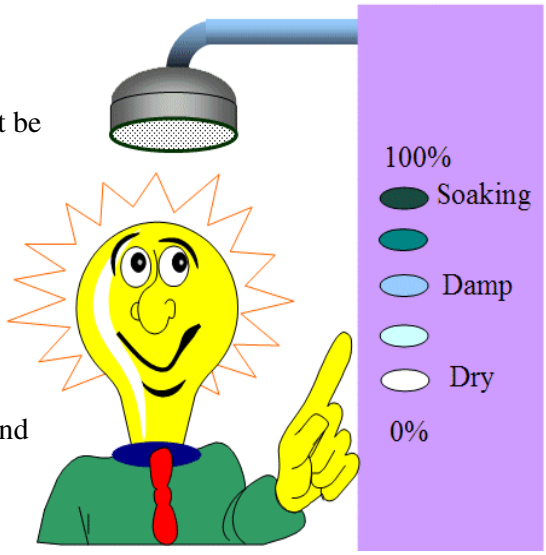
'Moisture beeper program 2. **Note** Picaxe08 (b2 = 0 to 160), Picaxe08M (b2 = 0 to 255).

```
Loop:
      Readadc 1, b2             'Read the value at Pin 1 into register b2.
      W0 = b2 * 5               'Multiply the analogue value by 5
      Pause W0                  'and wait accordingly in milliseconds (1.275seconds maximum)
      Sound 4, (110, 10)        'Make a tone on Port Pin 4
      Goto Loop                 'and repeat the exercise
```

3. What practical application could this type of circuit be used in the building industry to detect moisture?

4. Write a program using only one sound command line so that every half second the beeper sounds either one of three different tones for dry, moisture and Water.

5. For what purpose is it useful to have the beeper sound periodically when moisture is not being detected?



Exercises for Level 3.

Materials: Cup of water and a dry sponge cloth to help produce variable moisture content. Insulated hook up wire.

6. Develop a program to signal to the computer the moisture level from 0 to 100% using the Debug command.

Hints: Find the range of values for b2 that correspond from dry, damp and water conduction. Subtract the value b2 from the maximum value 255 and place the result into word W0. Multiply this value by 100 and then divide the result by 255.

For the Picaxe 08 the value b2 for Readadc will only register a maximum value of 160, therefore adjust the result W0 at this point to display 0% moisture.

Note: To view W0 register in the Debug window click on "Word" mode.

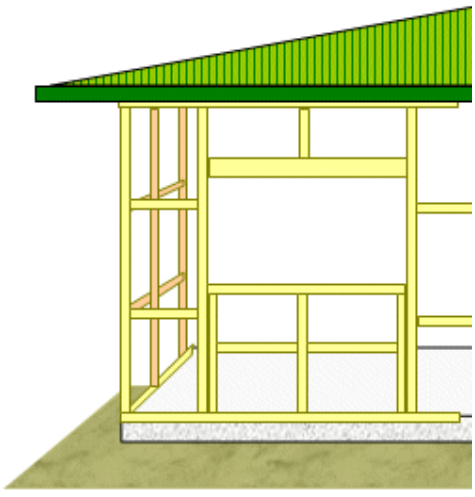
Design Project.

7. Present an idea of how this technology could be implemented as a practical hand held instrument suitable for the building industry?

Provide detailed drawings of how the circuit board and battery compartment can be arranged. Keep in mind the ergonomics and features that may help the user, e.g. belt or pocket clip etc.

8. Moisture resistance meter.
Develop a program to signal to the computer the moisture level in terms of resistance.
Use Kirchhoff's first Law to convert the value b2 to the equivalent resistance value W0.

Note: To view W0 in the Debug window click on "Word" mode.



Conclusion:

9. Report on the possibilities using this technology and problems that could be experienced.

Tutor Information and answers.

The value of resistance between the probes is proportional to the voltage that appears at Pin 1.
If Pin 1 is connected to the +5V supply rail the full-scale analogue value will register 255 for b2 with the
Picaxe 08M.

For the Picaxe 08 the value for b2 will stop at 160, which is 62.7% of supply rail voltage.
If the resistance of the water is 4.7MΩ, the voltage at Pin 1 will be half of the supply voltage.

⇒ (Rntc + R1a) / (Rntc + R1a + R1d) x Vsupply.
⇒ (4.7MΩ + 4.7kΩ) / (4.7MΩ + 4.7kΩ + 4.7MΩ) x 5V = 2.5V approximately.

The value for b2 will register approximately 127 for Picaxe 08M and 117 for Picaxe 08.

Note: You will not be able to measure this voltage accurately with a multimeter as the internal resistance
inside the multimeter across the test leads will influence the circuit resistance.

Answers

1. Detect water overflow and close off the water valve in a washing machine or dish-wash draw.

2. A switch activated by a float.
   An array of LEDs, LCD display, voice speaker or computer display.

3. A building inspector must first check the moisture content in the timber framework of a new house is sufficiently low enough before the builder can proceed to install the interior lining.

4. Three step tone moisture meter.

```
Loop:  b2 = 100                  'Set tone (register b2) to the lowest pitch
       Pause 500                 'Wait 500 milliseconds (0.5 seconds)
       Readadc 1, b1             'Read the analogue value at Pin 1 into the moisture register b1
       IF b1 >150 Then Tone1     'If the moisture level is greater than 150 (Dry) Low pitch
       IF b1 >60  Then Tone2     'If the moisture level is greater than 60 (moist) medium pitch

Tone3: b2 = 110                  'Otherwise set the tone ready to increase for high pitch and

Tone2: b2 = b2 + 10              'increase the pitch by 10

Tone1: Sound 4, (b2,20)          'Sound the appropriate tone out pin 4 for 20 milliseconds
       Goto Loop                 'and repeat the exercise
```

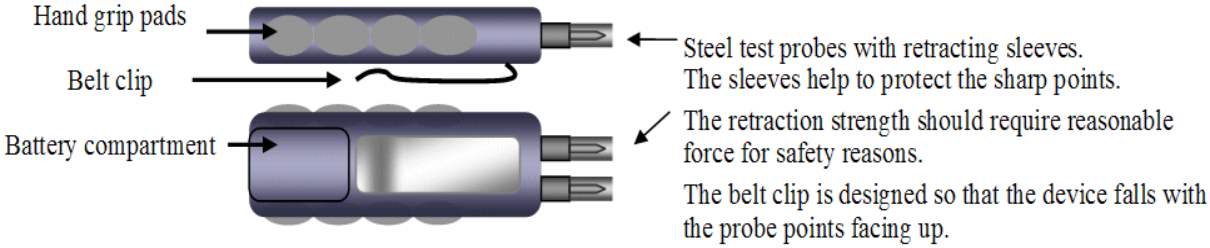
5. An intermittent audible or visual indicator will tell us that the battery does not need replacing.

6. The Picaxe 08 can not register a value greater than 160 for b2
therefore make the result 37% = 0 %

```
Loop:   Readadc 1,b2                ‘Read in the Pin 1 analogue value into b2 register
        W0 = 255 – b2 * 100 / 255   ‘Calculate the percentage
        IF W0 > 37 Then Display     ‘Insert this line for Picaxe 08 only
        W0 = 0                      ‘ Insert this line for Picaxe 08 to set < = 37% to 0%

Display: Debug W0                   ‘The result will appear on B0 = 0 to 100%
         Pause 100                  ‘Wait 100 milliseconds
         Goto Loop                  ‘and repeat the exercise
```

7. A moisture meter has two stainless steel pins that push into the timber frame work.



8. The value b2 is representative of the resistance of R1c.
Ignore R1a for this exercise.
The value (255 – b2) is representative of the resistance of R1d.

‘Moisture Resistance meter. *Test with a 1MΩ & 4.7 M Ω across the probes

```
Loop:   Readadc 1,b2        ‘Read in the Pin 1 analogue value into b2 register.
        b2 = b2 + 11        ‘Include this line for the Picaxe 08 only
                            ‘to help compensate for the resolution
        b3 = 255 - b2       ‘Calculate the ratio for R1d.
        W0 = b2 * 100 / b3  ‘Calculate the proportion of R1c x 100.
        W0 = W0 * 47        ‘Multiply this portion by the pull-up Resistor value 4.7MΩ.
        Debug W0            ‘display W0, multiple by 1,000 for the resistance value as
        Pause 100           ‘Wait 0.1second
                            ‘the maximum word value can only be 2^16 = 65,535.
        Goto Loop           ‘and repeat the exercise.
```

9. a. The Picaxe 08 has a low resolution of 16 steps so the result W0 will be just an approximation.

b. Water can contain different conductive minerals which will affect the results.