

LAMPIRAN

Lampiran 1. Datasheet Sensor DHT22

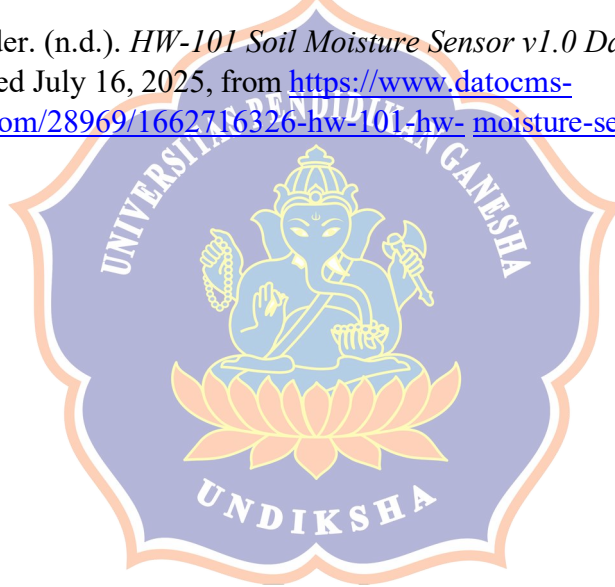
Aosong Electronics Co., Ltd. (n.d.). *DHT22 (AM2302) Temperature & Humidity Sensor Datasheet*. Retrieved July 16, 2025, from <https://cdn.sparkfun.com/assets/f/7/d/9/c/DHT22.pdf>

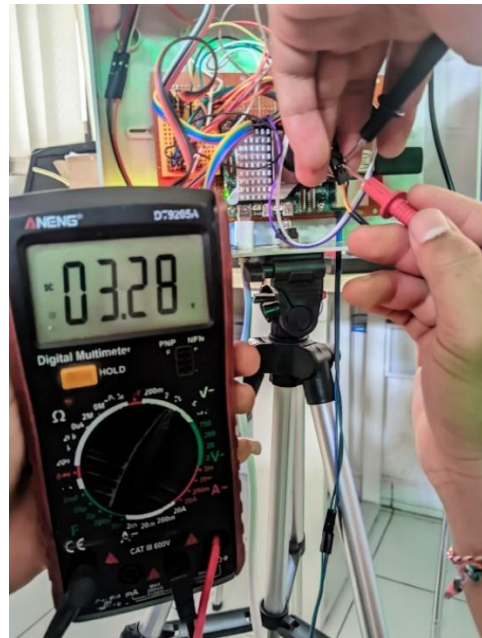
Lampiran 2. Datasheet Tipping Bucket Rain Gauge

Anamet s.r.o. (n.d.). *TBRG – Tipping Bucket Rain Gauge for Precipitation Measurement*. Retrieved July 16, 2025, from <https://www.anamet.cz/wp-content/uploads/2022/02/TBRG-letak.pdf>

Lampiran 3. Datasheet Soil Moisture Sensor

Hiwonder. (n.d.). *HW-101 Soil Moisture Sensor v1.0 Datasheet*. Retrieved July 16, 2025, from <https://www.datocms-assets.com/28969/1662716326-hw-101-hw-moisture-sensor-v1-0.pdf>

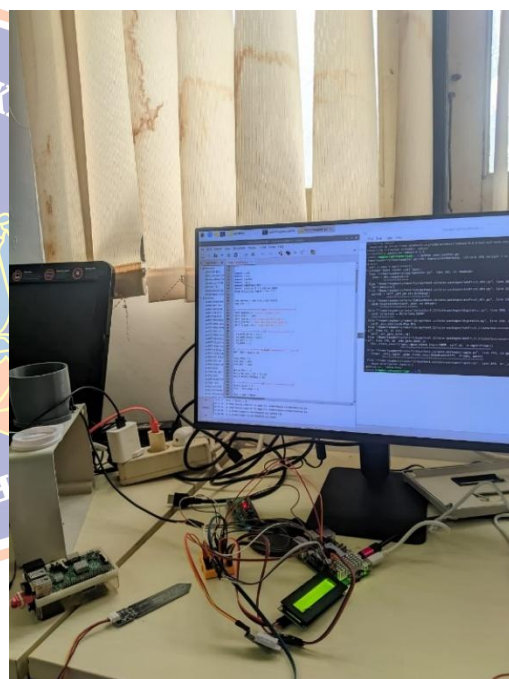




```

20 ADC_CHAN = 0 # Channel MCP3008 untuk soil
21
22 # Kalibrasi soil sensor
23 ADC_DRY = 900 # sensor di udara
24 ADC_WET = 300 # sensor tanah basah
25
26 # ===== INISIALISASI LCD ===== #
27 lcds: List[CharLCD] = []
28
29 for addr in LCD_ADDRS:
30     try:
31         lcd = CharLCD(
32             i2c_expander="PCF8574",
33             address=addr,
34             port=1,
35             cols=LCD_COLS,
36             rows=LCD_ROWS,
37             charmap="A00"
38         )
39         lcds.append(lcd)
40     except Exception as e:
41         print(f"LCD (hex{addr}) error:", e)
42
43 #Karakter derajat (°)
44 degree_char = [
45     0b00110,
46     0b01001,
47     0b01001,
48     0b00110,
49     0b00000,
50     0b00000,
51     0b00000,
52     0b00000,
53 ]
54 for lcd in lcds:
55     lcd.create_char(0, degree_char)
56
57 # ===== INISIALISASI DHT22 ===== #
58 SENSOR = Adafruit_DHT.DHT22
59
60 # ===== INISIALISASI SPI MCP3008 ===== #
61 spi = spidev.SpiDev()
62 spi.open(0, 0)

```





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FORMULIR BIMBINGAN TUGAS AKHIR

Nama	:	Ketut Adi Gunawan
Nim	:	22551001
Prodi	:	D4 Teknologi Rekayasa Sistem Elektronika
Pembimbing	:	Ketut Udy Ariawan, S.T., M.T
Judul	:	Pengembangan Sistem Monitoring Cuaca Real-Time berbasis Raspberry Pi Dan Iot Di Perkebunan
Pembahasan Mahasiswa : Melakukan bimbingan terkait dengan bab II yang membahas isi didalam bab III.		
Pembahasan Pembimbing : membimbing mahasiswa terkait dengan isi bab II dan apa yang terdapat di bab II.		
Hari/Tgl Jumat, 4 Juli 2023	TTD Mahasiswa Ketut Adi Gunawan Nim 2255021001	TTD Pembimbing Ketut Udy Ariawan, S.T., M.T NIP.1979012310121001



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FORMULIR BIMBINGAN TUGAS AKHIR

Nama	:	Ketut Adi Gunawan	
Nim	:	2255021001	
Prodi	:	D4 Teknologi Rekayasa Sistem Elektronika	
Pembimbing	:	Dr. Made Santo Giatarkarna, S.T., M.T.	
Judul	:	Pengembangan Sistem monitoring Cuaca Real-Time berbasis Raspberry pi dan IoT dipertelevisian.	
Pembahasan Mahasiswa :			
Pembuatan program Raspberry pi dan upload program Raspberry pi.			
Pembahasan Pembimbing :			
Membimbing mahasiswa pembuatan program dan cara Upload program.			
Hari/Tgl	Belasan 2 - Desember - 2025.		
TDD Mahasiswa	Ketut Adi Gunawan Nim. 2255021001		
TDD Pembimbing	Dr. Made Santo Giatarkarna. S.T., M.T.		



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Nama	:	Kelut Adi Gunawan.
Nim	:	2255 021001.
Prodi	:	04 Teknologi Rekayasa Sistem Elektronika.
Pembimbing	:	Dr. Made Santo Catarkarna, S.T., M.T.
Judul	:	Pengembangan sistem monitoring cuaca real-time berbasis Raspberry pi dan IOT di perkotaan.
Pembahasan Mahasiswa : Perakitan alat dan penyusunan bab III.		
Pembahasan Pembimbing : Membimbing MHS terkait dengan Perakitan alat dan Penyusunan Bab III.		
Hari/Tgl Sabtu, 4-10-2025	TDD Mahasiswa Kelut Adi Gunawan NIM. 2255021001.	TDD Pembimbing Dr. Made Santo Catarkarna S.T., M.T.



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Nama	:	Ketut Adi Gunawan
Nim	:	2255021001
Prodi	:	D4 Teknologi Rekayasa Sistem Elektronika
Pembimbing	:	Ketut Udy Ariawan, S.T., M.T
Judul	:	Pengembangan Sistem Monitoring Cuaca Real-Time berbasis Raspberry Pi Dan Iot Di Perkebunan.
Pembahasan Mahasiswa : membimbing terkait dengan penyusunan bab IV yang dimana mahasiswa sedikit bingung dengan isi bab IV		
Pembahasan Pembimbing : membimbing mahasiswa terkait dengan isi dalam bab IV yang dimana mahasiswa masih bingung dengan isi bab IV.		
Hari/Tgl	TTD Mahasiswa	TTD Pembimbing
Rabu, 3-Desember 2025.	 Ketut Adi Gunawan Nim. 2255021001	 Ketut Udy Ariawan, S.T., M.T NIP.197901232010121001

RIWAYAT HIDUP



Ketut Adi Gunawan, lahir di Penarukan, 28 Oktober 2003. Penulis lahir dari pasangan suami istri Bapak Nyoman Wisada dan Ibu Kadek Warsiki. Penulis berkebangsaan Indonesia dan beragama Hindu. Kini penulis bertempat di Jalan Samratulagi Gang Elang No.10 RT.003, Kecamatan Buleleng, Kabupaten Buleleng, Provinsi Bali.

Penulis menyelesaikan pendidikan di SD Negeri 3 Penarukan, dan lulus pada tahun 2016. Kemudian penulis melanjutkan di SMP Negeri 3 Singaraja, dan lulus pada tahun 2019. Pada tahun 2022, penulis lulus dari SMK Negeri 3 Singaraja jurusan Teknik Instalasi Tenaga Listrik dan melanjutkan ke Diploma IV Program Studi Teknologi Rekayasa Sistem Elektronika di Universitas Pendidikan Ganesha. Penulis sampai saat ini masih mengerjakan Tugas Akhir yang berjudul “PENGEMBANGAN SISTEM MONITORING CUACA REAL-TIME BERBASIS RASPBERRY PI DAN IOT DI PERKEBUNAN”.

PERNYATAAN KEASLIAN TULISAN

Dengan ini saya menyatakan bahwa karya tulis yang berjudul “PENGEMBANGAN SISTEM MONITORING CUACA REAL-TIME BERBASIS RASPBERRY PI DAN IOT DI PERKEBUNAN” beserta seluruh isinya adalah benar-benar karya sendiri dan saya tidak melakukan penjiplakan dan pengutipan dengan cara-cara yang tidak sesuai dengan etika yang berlaku dalam masyarakat keilmuan. Atas pernyataan ini, saya siap menanggung risiko/sanksi yang dijatuhkan kepada saya apabila kemudian ditemukan adanya pelanggaran atas etika keilmuan dalam karya saya ini atau ada klaim terhadap keaslian karya saya ini.



Aosong Electronics Co.,Ltd

Your specialist in innovating humidity & temperature sensors

Digital-output relative humidity & temperature sensor/module

DHT22 (DHT22 also named as AM2302)



Capacitive-type humidity and temperature module/sensor

1

Thomas Liu (Business Manager)

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1. Feature & Application:

- * Full range temperature compensated
- * Relative humidity and temperature measurement
- * Calibrated digital signal
- * Outstanding long-term stability
- * Extra components not needed
- * Long transmission distance
- * Low power consumption
- * 4 pins packaged and fully interchangeable

2. Description:

DHT22 output calibrated digital signal. It utilizes exclusive digital-signal-collecting-technique and humidity sensing technology, assuring its reliability and stability. Its sensing elements is connected with 8-bit single-chip computer.

Every sensor of this model is temperature compensated and calibrated in accurate calibration chamber and the calibration-coefficient is saved in type of programme in OTP memory, when the sensor is detecting, it will cite coefficient from memory.

Small size & low consumption & long transmission distance(20m) enable DHT22 to be suited in all kinds of harsh application occasions.

Single-row packaged with four pins, making the connection very convenient.

3. Technical Specification:

Model	DHT22
Power supply	3.3-6V DC
Output signal	digital signal via single-bus
Sensing element	Polymer capacitor
Operating range	humidity 0-100%RH; temperature -40~80Celsius
Accuracy	humidity +2%RH(Max +5%RH); temperature <+-0.5Celsius
Resolution or sensitivity	humidity 0.1%RH; temperature 0.1Celsius
Repeatability	humidity +-1%RH; temperature +-0.2Celsius
Humidity hysteresis	+0.3%RH
Long-term Stability	+0.5%RH/year
Sensing period	Average: 2s
Interchangeability	fully interchangeable
Dimensions	small size 14*18*5.5mm; big size 22*28*5mm

4. Dimensions: (unit---mm)

1) Small size dimensions: (unit---mm)

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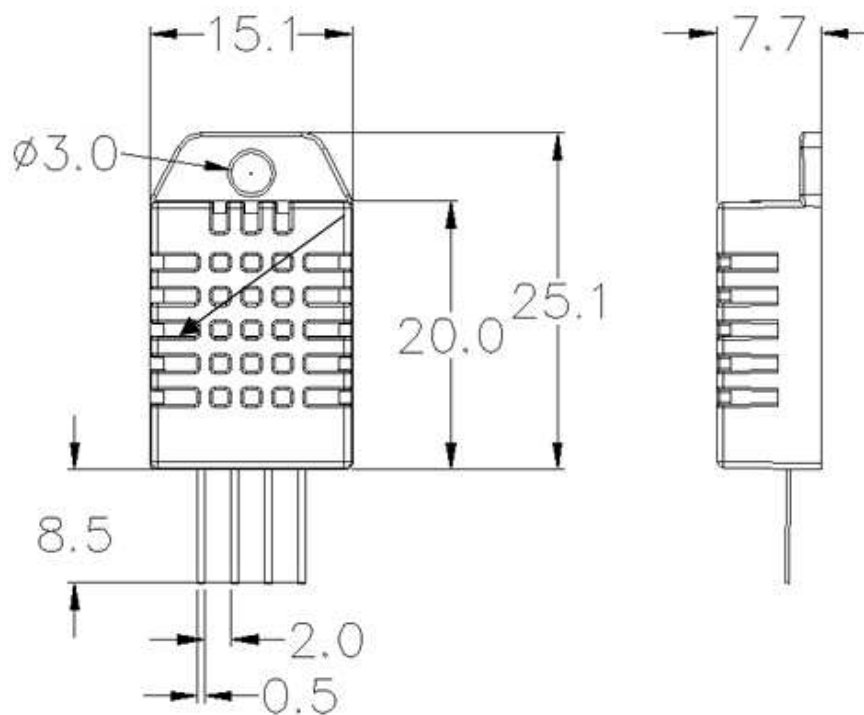
3

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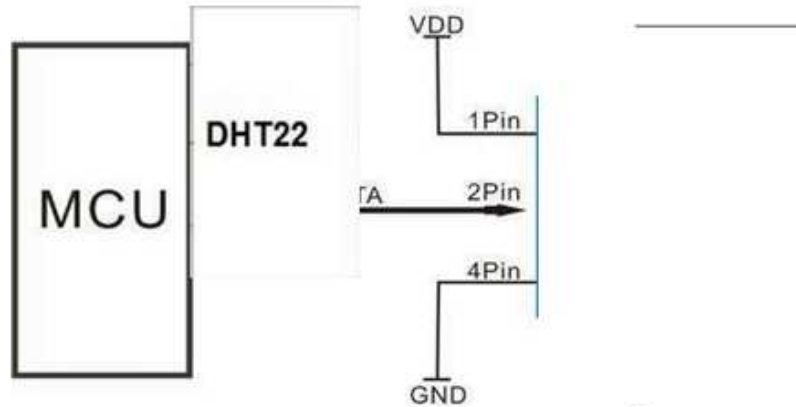
Pin sequence number: 1 2 3 4 (from left to right direction).

Pin	Function
1	VDD---power supply
2	DATA--signal
3	NULL
4	GND

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5. Electrical connection diagram:



3Pin---NC, AM2302 is another name for DHT22

6. Operating specifications:

(1) Power and Pins

Power's voltage should be 3.3-6V DC. When power is supplied to sensor, don't send any instruction to the sensor within one second to pass unstable status. One capacitor valued 100nF can be added between VDD and GND for wave filtering.

(2) Communication and signal

Single-bus data is used for communication between MCU and DHT22, it costs 5mS for single time communication.

Data is comprised of integral and decimal part, the following is the formula for data.

DHT22 send out higher data bit firstly!

DATA=8 bit integral RH data+8 bit decimal RH data+8 bit integral T data+8 bit decimal T data+8 bit check-sum
If the data transmission is right, check-sum should be the last 8 bit of "8 bit integral RH data+8 bit decimal RH data+8 bit integral T data+8 bit decimal T data".

When MCU send start signal, DHT22 change from low-power-consumption-mode to running-mode. When MCU finishs sending the start signal, DHT22 will send response signal of 40-bit data that reflect the relative humidity

5

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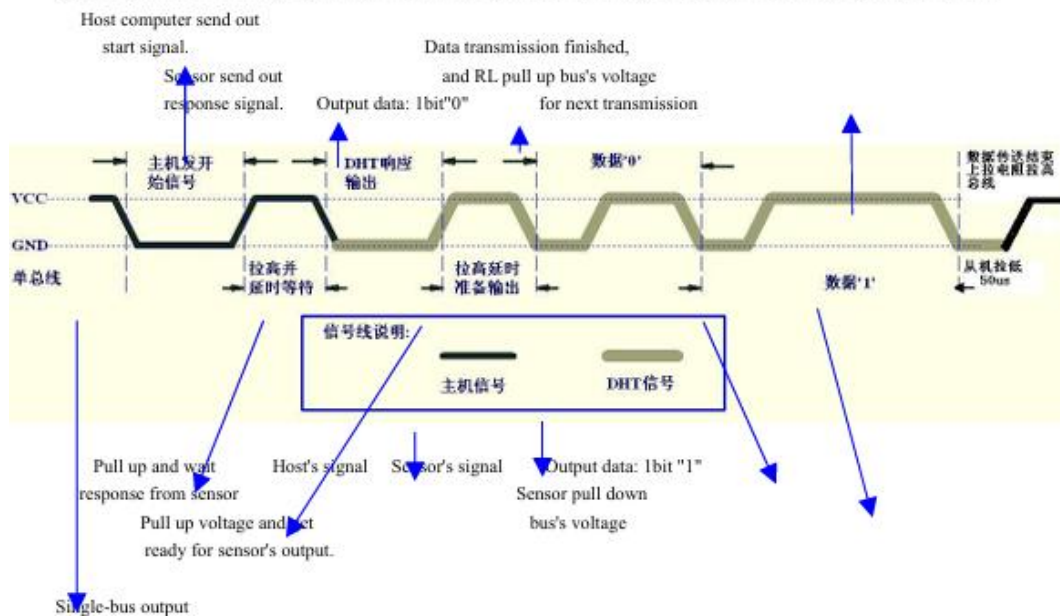
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and temperature information to MCU. Without start signal from MCU, DHT22 will not give response signal to MCU. One start signal for one time's response data that reflect the relative humidity and temperature information from DHT22. DHT22 will change to low-power-consumption-mode when data collecting finish if it don't receive start signal from MCU again.

1) Check bellow picture for overall communication process:



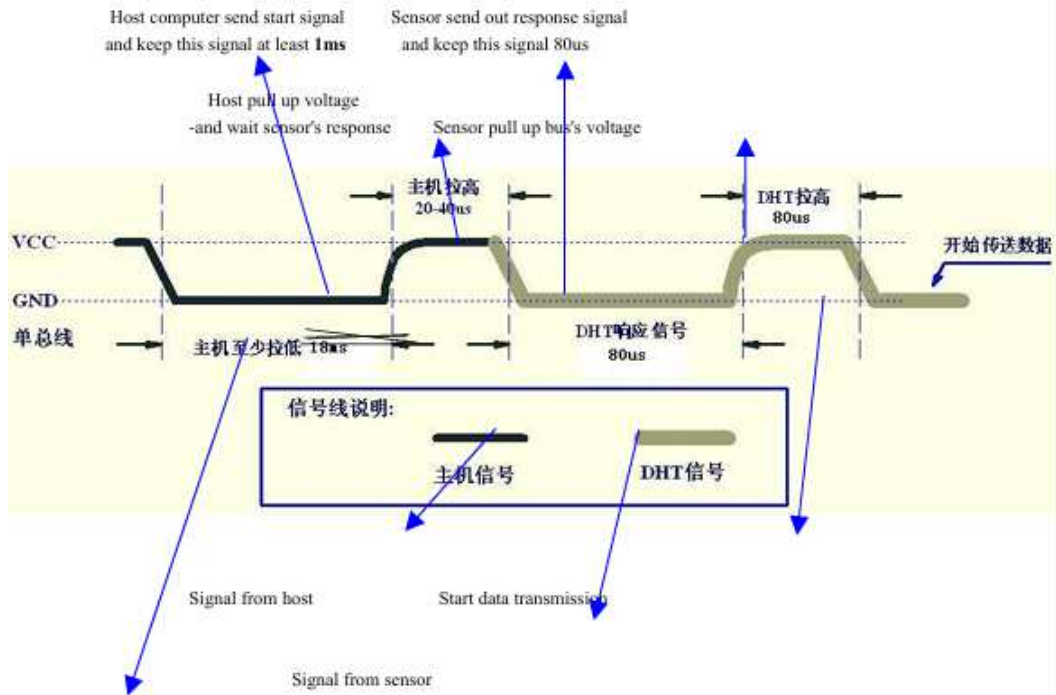
2) Step 1: MCU send out start signal to DHT22

Data-bus's free status is high voltage level. When communication between MCU and DHT22 begin, program of MCU will transform data-bus's voltage level from high to low level and this process must beyond at least 1ms to ensure DHT22 could detect MCU's signal, then MCU will wait 20-40us for DHT22's response.

Check bellow picture for step 1:

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Single-bus signal

Step 2: DHT22 send response signal to MCU

When DHT22 detect the start signal, DHT22 will send out low-voltage-level signal and this signal last 80us as response signal, then program of DHT22 transform data-bus's voltage level from low to high level and last 80us for DHT22's preparation to send data.

Check bellow picture for step 2:

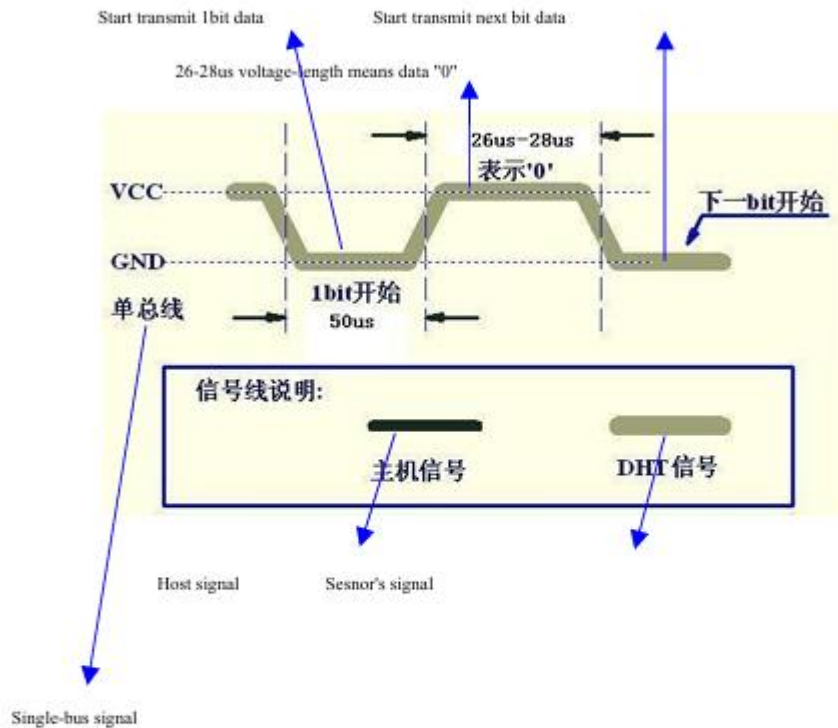
7

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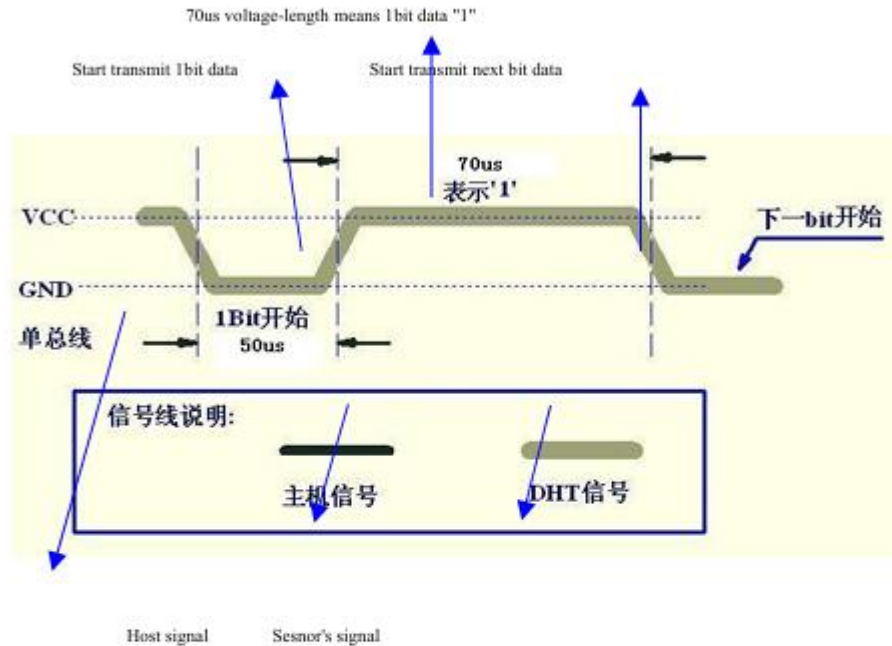
Step 3: DHT22 send data to MCU

When DHT22 is sending data to MCU, every bit's transmission begin with low-voltage-level that last 50us, the following high-voltage-level signal's length decide the bit is "1" or "0".

Check bellow picture for step 3:

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Single-bus signal

If signal from DHT22 is always high-voltage-level, it means DHT22 is not working properly, please check the electrical connection status.

7. Electrical Characteristics:

Item	Condition	Min	Typical	Max	Unit
Power supply	DC	3.3	5	6	V
Current supply	Measuring	1		1.5	mA
	Stand-by	40	Null	50	uA
Collecting period	Second		2		Second

*Collecting period should be : >2 second.

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8. Attentions of application:

(1) Operating and storage conditions

We don't recommend the applying RH-range beyond the range stated in this specification. The DHT22 sensor can recover after working in non-normal operating condition to calibrated status, but will accelerate sensors' aging.

(2) Attentions to chemical materials

Vapor from chemical materials may interfere DHT22's sensitive-elements and debase DHT22's sensitivity.

(3) Disposal when (1) & (2) happens

Step one: Keep the DHT22 sensor at condition of Temperature 50~60Celsius, humidity <10%RH for 2 hours;

Step two: After step one, keep the DHT22 sensor at condition of Temperature 20~30Celsius, humidity >70%RH for 5 hours.

(4) Attention to temperature's affection

Relative humidity strongly depend on temperature, that is why we use temperature compensation technology to ensure accurate measurement of RH. But it's still be much better to keep the sensor at same temperature when sensing.

DHT22 should be mounted at the place as far as possible from parts that may cause change to temperature.

(5) Attentions to light

Long time exposure to strong light and ultraviolet may debase DHT22's performance.

(6) Attentions to connection wires

The connection wires' quality will effect communication's quality and distance, high quality shielding-wire is recommended.

(7) Other attentions

* Welding temperature should be bellow 260Celsius.

* Avoid using the sensor under dew condition.

* Don't use this product in safety or emergency stop devices or any other occasion that failure of DHT22 may cause personal injury.

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HW-101 HW-moisture sensor V1.2

Specification





Features

1. New soil moisture sensor. This capacitive soil moisture sensor is different from most resistive sensors on the market. It uses the principle of capacitive sensing to detect soil moisture. The problem that the resistance sensor is easily corroded is avoided, and its working life is greatly extended.
2. The sensor has a built-in voltage regulator chip, which supports a 3.3~5.5V wide voltage working environment, which means that it can work normally even on the 3.3V Arduino main control board. The iconic DFRobot-Gravity interface ensures the compatibility of the interface and can be directly connected to the Gravity IO expansion board.
3. A micro PC such as a Raspberry Pi only needs an external ADC (analog signal to digital signal) conversion module to work.
4. With an external screen and a motherboard, you can talk to your plant to see if the beloved one is thirsty, and whether it needs a little more water.

Product parameters

Working voltage: 3.3 ~ 5.5 VDC

Output voltage: 0 ~ 3.0 VDC

Interface: PH2.54-3P

Size: 98 x 23mm (LxW)

Instructions

Prepare

Hardware

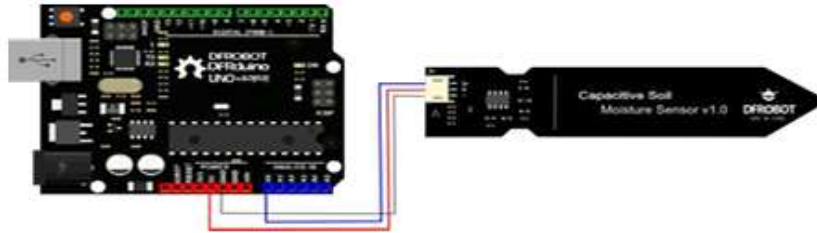
- UNO control board x1
- Soil moisture sensor x1
- PH2.54-3P wiring x1

Software

- Arduino IDE V1.6.5

Wiring diagram

1. Connect the sensor and the main control board as shown



Calibration code

1. Before officially testing the soil moisture, a calibration process is required;
2. Burn in the calibration code to the Arduino main control board;
3. Open the serial monitoring assistant.

```
void setup() {  
  Serial.begin(9600); // open serial port, set the baud rate to 9600 bps  
}  
void loop() {  
  int val;  
  val = analogRead(0); //connect sensor to Analog 0  
  Serial.print(val); //print the value to serial  
  delay(100);  
}
```

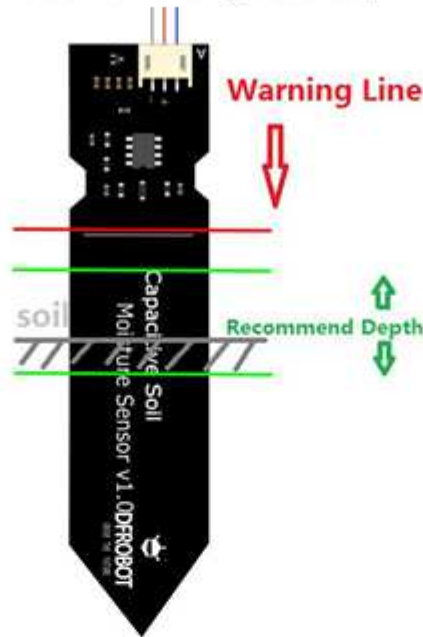
Calibration procedure

Dry humidity calibration

Calibration instructions: define a measurement range by reading the sensor values in air and water respectively.

Open the serial monitor and set the baud rate to 9600 according to the program.

First, place the sensor in the air to read the analog value, which represents the reading when dry. Then take a glass of water, insert the sensor into the water to a certain depth (make a mark, this depth is the depth you will insert into the soil), must not exceed the red warning line! And record the analog value read at this time, which represents 100% humidity. (The output data is inversely proportional to the humidity, and the output in the water is the smallest.) The insertion depth is recommended as shown in the figure.



Interval setting

Because the sensor value will be affected by the depth of the soil and the tightness of the soil, only the relative humidity of the soil can be detected. We divide the range of humidity into three equal parts, which means dry, humid, and very humid. The two data recorded before are the humidity interval. For example: the reading in the air is 520, and the reading in the water is 260, so it can be divided into (520,430), (430,350], (350,260). These three sections represent dry, wet, and very humid.

Note: Since this sensor will monitor soil moisture based on the principle of capacitive sensing, placing it in different places with different soil moisture, different tightness, and different insertion depth will reflect different humidity, even in the same place, at the same depth, at During the second insertion, since the first extraction has caused loosening of the soil, the humidity may be lower than the first reading. A

Note: Humidity is inversely proportional to the reading.

Test code

Bring the two sets of data just recorded into your test code.

```
/******  
This example reads Capacitive Soil Moisture Sensor.  
  
Created 2015-10-21  
By Bernie Chen <bernie.chen@dfrobot.com>
```



```
GNU Lesser General Public License.  
See <http://www.gnu.org/licenses/> for details.  
All above must be included in any redistribution  
*****/  
  
/*****Notice and Trouble shooting*****/  
1.Connection and Diagram can be found here  
2.This code is tested on Arduino Uno.  
*****/  
  
const int AirValue = 520; //you need to change this value that you had recorded in the air  
const int WaterValue = 260; //you need to change this value that you had recorded in the water  
int intervals = (AirValue - WaterValue)/3;  
int soilMoistureValue = 0;  
void setup() {  
  Serial.begin(9600); // open serial port, set the baud rate to 9600 bps  
}  
void loop() {  
  soilMoistureValue = analogRead(A0); //put Sensor insert into soil  
  if(soilMoistureValue > WaterValue && soilMoistureValue < (WaterValue + intervals))  
  {  
    Serial.println("Very Wet");  
  }  
  else if(soilMoistureValue > (WaterValue + intervals) && soilMoistureValue < (AirValue - intervals))  
  {  
    Serial.println("Wet");  
  }  
  else if(soilMoistureValue < AirValue && soilMoistureValue > (AirValue - intervals))  
  {  
    Serial.println("Dry");  
  }  
  delay(100);  
}
```

RFQ

Q 1. Why is my reading very different from the actual value, I use your Romeo?

A: Hello! Because Romeo's analog port A0 has an external button, please set the switch next to the button to Off, or use another analog port.

CASELLA



Tipping Bucket Rain Gauge (TBRG)

The Perfect Rain Gauge for Professionals.

Casella's TBRG is designed to meet WMO requirements for precipitation measurements. Easy to deploy, it provides high precision with minimum maintenance.

www.casellasolutions.com

Overview

The Classic Tilt is a reliable and extremely robust tilt gauge. The body and funnel are made from aluminium alloy, with the accurately machined aluminium ring at the top giving a height of 480mm.

The Tipping Bucket has three available ring versions:

- 1 - A standard base-fitted version
- 2 - A standard base-fitted version for more severe weather conditions

Accurate and Precise Measurements

The Tilt's mechanism is purposefully made from light weight, injection moulded plastic and stainless steel parts to reduce the likelihood of errors. This is achieved by creating a ruling, which rather than a protrusion when the bucket tilts through the use of a fibre glass steel plate.

The Tipping Bucket mechanism is contained on a cast plate which also base, which incorporates a built-in spirit level to achieve correct and accurate positioning of the bucket.



Assembly

The rain gauge is pre-assembled from an easy-to-use standard components. The base and tipping ring are cast in stainless steel and the lid is, laser-treated and protective coated.

The tipping ring and funnel are fabricated from stainless steel by laser and again protective coated. The stainless steel is employed to protect the metal against the ingress of foreign bodies.

The use of stainless steel switches means the rain gauge is capable of long working life with little maintenance.

Applications

- Hydrology
- Sea and coastal monitoring
- Weather distribution and intensity
- Remote monitoring
- Landfill/runoff monitoring
- Irrigation studies
- Agriculture
- Climate change studies

Specification

General Specifications

Standard	BS7881-3:2012
Bucket size	0.5m ³ or 2m ³ or 500mm
Age limit	200 up to 400 years
Accuracy	±0.1 mm/decade
Capacity	Unlimited
Temperature	Temperature/5mm/decade
Operating temp. range	1°C to 85°C
Output	Contact closure
Weight	5.5 kg

Heated Version - Additional Specifications

Heater supply voltage	24V AC
Heater power consumption	43 Watts
Cable rating	3 x 0.75 mm ² AC, 4-core
Temperature range	-20°C to 85°C
Operating temp. range	-20°C to 85°C

Ordering Information

Type	Sensitivity	Output	Catalogue Reference
Standard (unheated)	0.1mm	Single	1004110
	0.2mm	Single	1004080
	0.5mm	Single	1004100
Standard (heated)	0.1mm	Single	1004090
	0.2mm	Single	1004060
	0.5mm	Single	1004080

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