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SKU:SEN0609

INTRODUCTION

The C4001(25m) millimeter-wave presence sensor utilizes a wavelength signal of 24GHz. It has a detection range of 100° horizontally, with a presence detection range of 16 meters and a motion detection and distance measurement range of 25 meters.

Human detection

Compared to other types of presence sensors such as infrared sensors and ultrasonic sensors, the C4001(25m) millimeter-wave presence sensor has the advantage of being able to detect both static and moving objects. It also has a relatively strong anti-interference ability, making it less susceptible to factors such as temperature changes, variations in ambient light, and environmental noise. Whether a person is sitting, sleeping, or in motion, the sensor can quickly and sensitively detect their presence.

	Millimeter-wave Presence Sensor	Infrared Sensor
Sensing Principle	TOF radar principle + Doppler radar sensing principle (active detection)	Pyroelectric infrared sensing principle (passive radiation)
Motion Sensitivity	Can detect presence, slight movement, and motion of human body	Can only detect motion and close-range slight movement of human body
Sensing Range	Can be adjusted to different sensing distances	Sensing range cannot be adjusted
Environmental Temperature Impact	Not affected by environmental temperature	Sensitivity decreases when temperature is close to human body temperature
Application Environment	Not affected by heat sources, light sources, air flow	Susceptible to heat sources and air flow
Penetration Ability	Can penetrate fabrics, plastics, glass, and other insulating materials	Can only penetrate some transparent plastics
Distance Measurement Support	Yes	No

Distance and velocity detection

The C4001(25m) millimeter-wave presence sensor utilizes Frequency Modulated Continuous Wave (FMCW) modulation for distance and speed measurement. It has a maximum measurement range of 25 meters for distance and a speed measurement range of 0.1 to 10 meters per second.

FMCW is a radar system based on Frequency Modulated Continuous Wave. Unlike traditional pulse radar, FMCW radar continuously emits a series of continuous wave signals with gradually changing frequencies while simultaneously receiving the reflected signals. By analyzing the received signals, measurements of parameters such as distance, velocity, and angle can be achieved.

Compared to traditional pulse radar technology, FMCW radar can continuously measure the distance of objects. By utilizing the Doppler effect, it can also obtain velocity information of the target objects. This makes it suitable for applications that require monitoring the motion status of target objects. Additionally, FMCW radar can achieve continuous frequency scanning, providing higher measurement resolution. Since it doesn't need to wait for the echo signal to return, it is suitable for applications that require real-time monitoring and tracking of target objects.

What is a millimeter-wave radar sensor?

Millimeter-wave radar technology is a non-contact sensing technology used to detect objects and provide information about their distance, velocity, and angle (in the case of humans, for example). The signals emitted by millimeter-wave sensors fall within the high-frequency spectrum with wavelengths between 24GHz and 300 GHz, also known as the millimeter (mm) range.

Characteristics

- Human detection: Detection range up to 16 meters and motion detection range up to 25 meters.
- Distance detection: Range from 1.2 meters to 25 meters.
- Velocity detection: Range from 0.1 meters per second to 10 meters per second.
- Strong anti-interference capability, unaffected by snow, haze, temperature, humidity, dust, light, noise, etc.
- High and low level output control through I/O ports.
- Input and output control via serial port.
- Small size, easy to integrate.

Specification

- Operating voltage: 3.3/5V
- Maximum detection range: 25m
- Beam angle: 100*40°
- Modulation mode: FMCW
- Operating frequency: 24GHz
- Operating temperature: -40~85℃
- Baud rate: 9600
- Size: 26*30mm

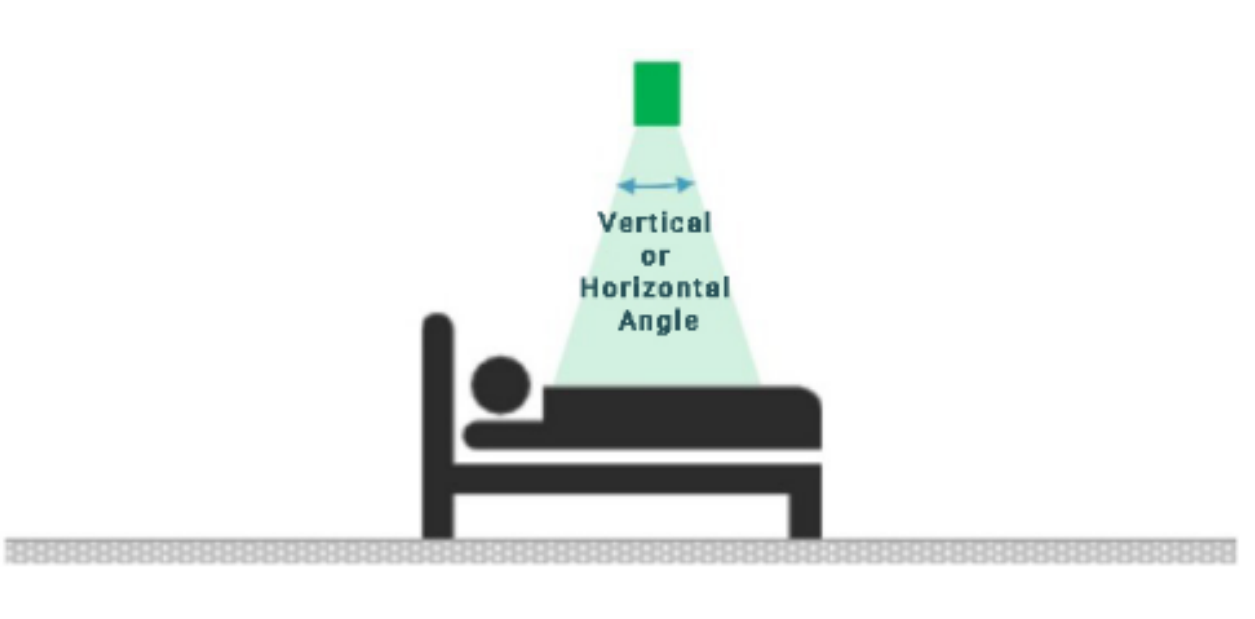
Interface Definitions

Definition	Explanation
VIN	Power supply
GND	Ground
RX	Sensor serial port receive
TX	Sensor serial port transmit
OUT	Voltage output

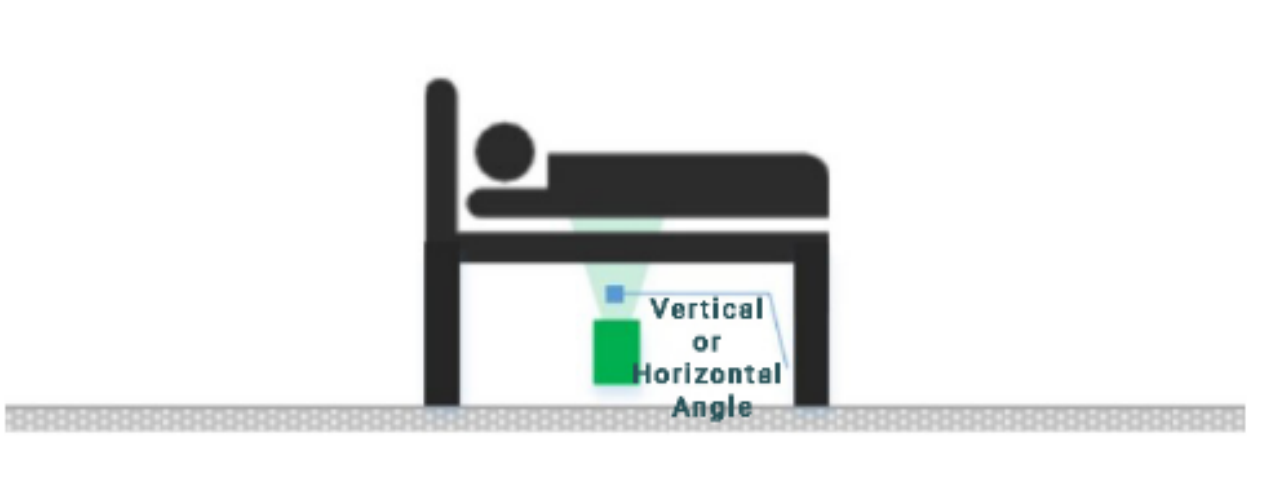
Installation Method

The millimeter-wave human body sensor is sensitive to the installation method, and improper installation can affect the performance and functionality of the sensor. The commonly used installation methods for this module include top installation, bottom installation, horizontal installation, and downward tilted installation.

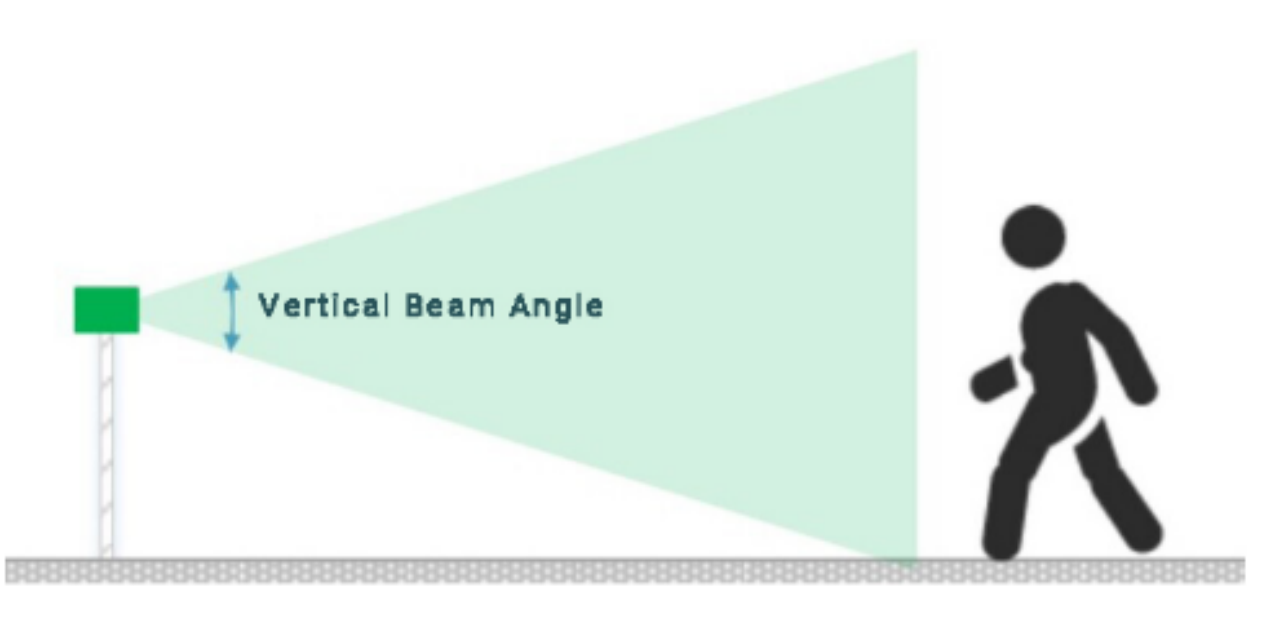
Top Installation



Bottom Installation



Horizontal Installation



Demo Program

There is information retrieval.

Preparation

- Hardware
  - C4001 Millimeter Wave Presence Sensor 12m
  - Arduino Uno
- Software

  Arduino IDE, Click to download Arduino IDE

  DFRobot_C4001 library, Click to download the DFRobot_C4001 library.

Wiring diagram

MmWave	Arduino Uno
VIN	5V
GND	GND
RX	D5
TX	D4

Sample code

Please copy the following code and upload it to your Arduino IDE.

```
 /*!
  * @file  motionDetection.ino
  * @brief  Example of radar detecting whether an object is mo
  * @copyright Copyright (c) 2010 DFRobot Co.Ltd (http://www.d
  * @license The MIT License (MIT)
  * @author ZhixinLiu(zhixin.liu@dfrobot.com)
  * @version V1.0
  * @date 2024-02-02
  * @url https://github.com/dfrobot/DFRobot_C4001
  */

#include "DFRobot_C4001.h"

//#define I2C_COMMUNICATION  //use I2C for communication, but

#ifdef  I2C_COMMUNICATION
  /*
   * DEVICE_ADDR_0 = 0x2A     default iic_address
   * DEVICE_ADDR_1 = 0x2B
   */
  DFRobot_C4001_I2C radar(&Wire ,DEVICE_ADDR_0);
#else
/* ---------------------------------------------------------------
 *    board   |             MCU                | Leonardo/Mega
 *     VCC    |            3.3V/5V             |      VCC
 *     GND    |              GND               |      GND
 *     RX     |              TX                |    Serial1 T
 *     TX     |              RX                |    Serial1 R
 * ---------------------------------------------------------------
/* Baud rate cannot be changed */
  #if defined(ARDUINO_AVR_UNO) || defined(ESP8266)
    SoftwareSerial mySerial(4, 5);
    DFRobot_C4001_UART radar(&mySerial ,9600);
  #elif defined(ESP32)
    DFRobot_C4001_UART radar(&Serial1 ,9600 ,/*rx*/D2 ,/*tx*/D
  #else
    DFRobot_C4001_UART radar(&Serial1 ,9600);
  #endif
#endif

void setup()
{
  Serial.begin(115200);
  while(!Serial);
  while(!radar.begin()){
    Serial.println("NO Deivces !");
    delay(1000);
  }
  Serial.println("Device connected!");

  // exist Mode
  radar.setSensorMode(eExitMode);

  sSensorStatus_t data;
  data = radar.getStatus();
  //  0 stop  1 start
  Serial.print("work status  = ");
  Serial.println(data.workStatus);

  //  0 is exist   1 speed
  Serial.print("work mode  = ");
  Serial.println(data.workMode);

  //  0 no init    1 init success
  Serial.print("init status = ");
  Serial.println(data.initStatus);
  Serial.println();

  /*
   * min Detection range Minimum distance, unit cm, range 0.3~
   * max Detection range Maximum distance, unit cm, range 2.4~
   * trig Detection range Maximum distance, unit cm, default t
   */
  if(radar.setDetectionRange(/*min*/30, /*max*/1000, /*trig*/1
    Serial.println("set detection range successfully!");
  }
  // set trigger sensitivity 0 - 9
  if(radar.setTrigSensitivity(1)){
    Serial.println("set trig sensitivity successfully!");
  }

  // set keep sensitivity 0 - 9
  if(radar.setKeepSensitivity(2)){
    Serial.println("set keep sensitivity successfully!");
  }
  /*
   * trig Trigger delay, unit 0.01s, range 0~2s (0~200)
   * keep Maintain the detection timeout, unit 0.5s, range 2~1
   */
  if(radar.setDelay(/*trig*/100, /*keep*/4)){
    Serial.println("set delay successfully!");
  }


  // get confige params
  Serial.print("trig sensitivity = ");
  Serial.println(radar.getTrigSensitivity());
  Serial.print("keep sensitivity = ");
  Serial.println(radar.getKeepSensitivity());

  Serial.print("min range = ");
  Serial.println(radar.getMinRange());
  Serial.print("max range = ");
  Serial.println(radar.getMaxRange());
  Serial.print("trig range = ");
  Serial.println(radar.getTrigRange());

  Serial.print("keep time = ");
  Serial.println(radar.getKeepTimerout());

  Serial.print("trig delay = ");
  Serial.println(radar.getTrigDelay());

}

void loop()
{
  // Determine whether the object is moving
  if(radar.motionDetection()){
    Serial.println("exist motion");
    Serial.println();
  }
  delay(100);
}
```

result

例程1结果

Distance speed acquisition

Preparation

- Hardware
  - C4001 Millimeter Wave Presence Sensor 12m
  - Arduino Uno
- Software

  Arduino IDE, Click to download Arduino IDE

  DFRobot_C4001 library, Click to download the DFRobot_C4001 library.

Wiring diagram

MmWave	Arduino Uno
VIN	5V
GND	GND
RX	D5
TX	D4

Sample code

Please copy the following code and upload it to your Arduino IDE.

```
/*!
  * @file  mRangeVelocity.ino
  * @brief  radar measurement demo
  * @copyright Copyright (c) 2010 DFRobot Co.Ltd (http://www.d
  * @license The MIT License (MIT)
  * @author ZhixinLiu(zhixin.liu@dfrobot.com)
  * @version V1.0
  * @date 2024-02-02
  * @url https://github.com/dfrobot/DFRobot_C4001
  */

#include "DFRobot_C4001.h"

//#define I2C_COMMUNICATION  //use I2C for communication, but

#ifdef I2C_COMMUNICATION
/*
   * DEVICE_ADDR_0 = 0x2A     default iic_address
   * DEVICE_ADDR_1 = 0x2B
   */
DFRobot_C4001_I2C radar(&Wire, DEVICE_ADDR_0);
#else
/* ---------------------------------------------------------------
 *    board   |             MCU                | Leonardo/Mega
 *     VCC    |            3.3V/5V             |      VCC
 *     GND    |              GND               |      GND
 *     RX     |              TX                |    Serial1 T
 *     TX     |              RX                |    Serial1 R
 * ---------------------------------------------------------------
/* Baud rate cannot be changed */
#if defined(ARDUINO_AVR_UNO) || defined(ESP8266)
SoftwareSerial mySerial(4, 5);
DFRobot_C4001_UART radar(&mySerial, 9600);
#elif defined(ESP32)
DFRobot_C4001_UART radar(&Serial1, 9600, /*rx*/ D2, /*tx*/ D3)
#else
DFRobot_C4001_UART radar(&Serial1, 9600);
#endif
#endif

void setup() {
  Serial.begin(115200);
  while (!Serial)
    ;
  while (!radar.begin()) {
    Serial.println("NO Deivces !");
    delay(1000);
  }
  Serial.println("Device connected!");

  // speed Mode
  radar.setSensorMode(eSpeedMode);

  sSensorStatus_t data;
  data = radar.getStatus();
  //  0 stop  1 start
  Serial.print("work status  = ");
  Serial.println(data.workStatus);

  //  0 is exist   1 speed
  Serial.print("work mode  = ");
  Serial.println(data.workMode);

  //  0 no init    1 init success
  Serial.print("init status = ");
  Serial.println(data.initStatus);
  Serial.println();

  /*
   * min Detection range Minimum distance, unit cm, range 0.3~
   * max Detection range Maximum distance, unit cm, range 2.4~
   * thres Target detection threshold, dimensionless unit 0.1,
   */
  if (radar.setDetectThres(/*min*/ 11, /*max*/ 1200, /*thres*/
    Serial.println("set detect threshold successfully");
  }

  // set Fretting Detection
  radar.setFrettingDetection(eON);

  // get confige params
  Serial.print("min range = ");
  Serial.println(radar.getTMinRange());
  Serial.print("max range = ");
  Serial.println(radar.getTMaxRange());
  Serial.print("threshold range = ");
  Serial.println(radar.getThresRange());
  Serial.print("fretting detection = ");
  Serial.println(radar.getFrettingDetection());
}

void loop() {
  Serial.print("target number = ");
  Serial.println(radar.getTargetNumber());  // must exist
  Serial.print("target Speed  = ");
  Serial.print(radar.getTargetSpeed());
  Serial.println(" m/s");

  Serial.print("target range  = ");
  Serial.print(radar.getTargetRange());
  Serial.println(" m");

  Serial.print("target energy  = ");
  Serial.println(radar.getTargetEnergy());
  Serial.println();
  delay(100);
}
```

result

例程1结果

FAQ

If you have any questions about using this product, please check theComprehensive Guide to Smart Home Presence Detection (FAQ)for that product for a corresponding solution.

And for any questions, advice or cool ideas to share, please visit the **DFRobot Forum**.

More Documents

SEN0609 Communication protocol.pdf

dimensional drawing

DFRobot purchase link in the online store