

3. DHT11 Sensor Interfacing

3.1 Sensor Fundamentals

A sensor captures physical phenomena from the real world and converts them into electrical signals (analog or digital) for computation.

For DHT11 specifically:

- It measures temperature and humidity.
- It is commonly used in educational and basic room-monitoring applications.
- Typical module-noted range:
 - Temperature: 0 to 50 deg C
 - Humidity: 20% to 90% RH

3.2 DHT11 Variants and Wiring

DHT11 can be found as:

- bare sensor package,
- breakout module.

Breakout modules are typically easier to wire and often include support components.

3.3 DHT11 Protocol and Timing

DHT11 uses a single-wire, pulse-width-based digital protocol. Communication sequence:

1. MCU sends start signal (low pulse around 18-20 ms, then high).
2. DHT11 sends response pulse.
3. DHT11 transmits 40-bit serial data.
4. Bit value is represented by pulse width:
 - short high pulse = 0
 - long high pulse = 1

3.4 40-bit Data Format

Byte	Data Field
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1	Humidity integer part
2	Humidity decimal part
3	Temperature integer part
4	Temperature decimal part
5	Checksum

Checksum rule:

Checksum = (Byte1 + Byte2 + Byte3 + Byte4) & 0xFF

3.5 Why Accurate Delay Matters

DHT11 decoding depends on timing precision. If delays are too short or too long:

- start handshake may fail,
- bit sampling can shift,
- decoded bytes can become invalid,
- checksum mismatch may occur.

3.6 DHT11 Assembly Example

```

;-----
; Assembly Code
;-----
#define __SFR_OFFSET 0x00
#include "avr/io.h"
;-----
.global main
;=====
main:
;-----
    LDI    R17, 0xFF
    OUT    DDRC, R17    ;set port C for o/p
    OUT    DDRD, R17    ;set port D for o/p

;-----
agn:RCALL delay_2s    ;wait 2s for DHT11 to get ready
;-----
;send start signal
;-----
    SBI    DDRB, 1      ;pin PB0 as o/p

```

```

CBI  PORTB, 1      ;first, send low pulse
RCALL delay_20ms   ;for 20ms
SBI  PORTB, 1      ;then send high pulse
;-----
;wait for response signal
;-----
CBI  DDRB, 1       ;pin PB0 as i/p
w1: SBIC PINB, 1
RJMP w1            ;wait for DHT11 low pulse
w2: SBIS PINB, 1
RJMP w2            ;wait for DHT11 high pulse
w3: SBIC PINB, 1
RJMP w3            ;wait for DHT11 low pulse
;-----
RCALL DHT11_reading ;read humidity (1st byte of 40-bit data)
MOV  R19, R18
RCALL DHT11_reading
RCALL DHT11_reading ;read temp (3rd byte of 40-bit data)
;-----
OUT  PORTD, R19    ;o/p temp byte to port C
OUT  PORTC, R18    ;o/p humidity byte to port D
RJMP agn           ;go back & get another sensor reading
;=====
DHT11_reading:
LDI  R17, 8        ;set counter for receiving 8 bits
CLR  R18           ;clear data register
;-----
w4: SBIS PINB, 1
RJMP w4            ;detect data bit (high pulse)
RCALL delay_timer0 ;wait 50us then check bit value
;-----
SBIS PINB, 1       ;if bit=1, skip next instruction
RJMP skp           ;else bit=0
SEC                ;C=1
ROL  R18           ;shift in 1
RJMP w5
skp:LSL R18        ;shift in 0
;-----
w5: SBIC PINB, 1
RJMP w5            ;wait for low pulse
;-----

```

DEC R17

BRNE w4

RET

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