**Important Factors in a Greenhouse**

This is the brief tutorial of how special parameters affect greenhouse and its plants.

**IOT Based Parameters**

These parameters should be handled by using IOT based sensors and systems.

Using moving average algorithm. ZigBee protocol to ad-hoc communication.

**Sensors:**

**Carbon Di-Oxide**

Electrochemical gas sensor

Advantages: high speed, real-time sensing, low power consumption, high contamination tolerance and small in size.

Disadvantages: carbon monoxide often coexists with CO2 and absorbs a similar wave-length range as CO2 which results in inaccurate readings. They are also very expensive.

[1]

**Temperature**

**Type**: Integrated Circuit (IC) Temperature sensors

**Advantages**: low cost, excellent linearity and easy-to-read output.

**Disadvantages**: limited temperature range, self-heating, fragile and slightly less accurate when compared to other types.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Power supply | Current supply | Operating range | Accuracy | Dimensions | Resolution or sensitivity | Output signal | Price |
| DHT22 | 3.3-6V DC | 1-1.5 mA | Humidity  0-100% RH  Temperature  40~80Celsius | Humidity ±2% RH (Max±5%RH)  Temperature <±0.5Celsius | Small size 14\*18\*5.5mm | Humidity 0.1%RH;  Temperature 0.1Celsius | Digital signal via single-bus | 4$ |

Referenced to DHT22 Datasheet

**Humidity**

**Type**: Capacitive Humidity Sensors (CHSs)

**Advantages**: able to function in high temperature environments (up to 200°C), near linear voltage output, wide RH (Relative Humidity) range, high condensation tolerance, reasonable resistance to chemical vapors and contaminants, minimal long-term drift, high accuracy, small size and low cost

**Disadvantages**: limited sensing distance and sensor interface can be tedious and difficult.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Power supply | Current supply | Operating range | Accuracy | Dimensions | Resolution or sensitivity | Output signal | Price |
| DHT22 | 3.3-6V DC | 1-1.5 mA | Humidity  0-100% RH  Temperature  40~80Celsius | Humidity ±2% RH (Max±5%RH)  Temperature <±0.5Celsius | Small size 14\*18\*5.5mm | Humidity 0.1%RH;  Temperature 0.1Celsius | Digital signal via single-bus | 4$ |

Referenced to DHT22 Datasheet

**Light Intensity**

**Type**: Light Dependent Resistor (LDR)

**Advantages**: very cheap, fast response, linear output, and small in size.

**Disadvantages**: like photometric sensors, LDRs are mostly used to measure indoor lighting conditions.

[1]

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| --- | --- | --- | --- | --- | --- |
| Model | Photo Resistance (10Lx) (KΩ) | Dark Resistance (MΩ)min | γ min | Dimensions | Price |
| PGM5637D | 16 ~ 50 | 5.0 | 0.7 | 5.1mm\*4.3mm | 0.5$ |

Referenced to PGM5637D Datasheet

**Soil Moisture**

**Type**: Frequency Domain Reflectometry (FDR) Soil Moisture Sensor

**Advantages**: highly accurate, fast response time and inexpensive

**Disadvantages**: need to be calibrated for the type of soil they will be buried in.

[1]

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| --- | --- | --- | --- | --- | --- | --- |
| Model | Working Voltage | Working Current | Interface | Size | Output Voltage Signal | Price |
| YL-69 | 5V | 20 mA | Analog - Digital | 63\*20\*8 mm | 0-4.2V | 1$ |

Referenced to YL-69 Datasheet

**Soil Acidity**

## Image Processing Solutions

## Machine Learning and Fuzzy Logic Solutions

## GUI

Python – Android Studio

**References**

# [1] [Vu Minh Quan](https://ieeexplore.ieee.org/search/searchresult.jsp?searchWithin=%22First%20Name%22:%22Vu%20Minh%22&searchWithin=%22Last%20Name%22:%22Quan%22&newsearch=true), [Gourab Sen Gupta](https://ieeexplore.ieee.org/search/searchresult.jsp?searchWithin=%22First%20Name%22:%22Gourab%22&searchWithin=%22Last%20Name%22:%22Sen%20Gupta%22&newsearch=true), [Subhas Mukhopadhyay](https://ieeexplore.ieee.org/search/searchresult.jsp?searchWithin=%22First%20Name%22:%22Subhas%22&searchWithin=%22Last%20Name%22:%22Mukhopadhyay%22&newsearch=true), (2011), “Review of sensors for greenhouse climate monitoring”, **Publisher**:****IEEE

[2]