# Advancement of Community Weather Information Network through the Use of Low-cost Automatic Weather Station

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# *Direction*

Discuss about

(1) next generation of community weather information network,

(2) its implementation, and

(3) future work

# *Community Weather Information Network (Co-WIN)*

1. First launched in 2007, now a joint project between Hong Kong Observatory (HKO), the HK Polytechnic University (PolyU), and the Chinese University of HK (CUHK)

2. Encourage AWS at own premises, provided with professional advice and assistance

3. Objective – real-time meteorological data sharing, promote weather and climate




香港天文台 HONG KONG OBSERVATORY

# *Co-WIN*

## Existing Co-WIN

1. Tailor-made software developed by HKO and PolyU, ensuring data synchronization, integrity of AWS system settings and standardizing the AWS data format before transmission.

2. Weather elements – T, RH, P, wind speed, wind direction, rainfall amount.

3. Up to the end of Sept 2017, 160 members
   most of them primary and secondary schools

# Co-WIN


社區天氣資訊網絡
COMMUNITY WEATHER INFORMATION NETWORK
香港天文台
HONG KONG OBSERVATORY
香港中文大學
The Chinese University of Hong Kong
POLYTECHNIC UNIVERSITY
DEPARTMENT OF APPLIED PHYSICS
What's New
About Us
Weather Data +
Photo Gallery
Educational Resources
CWOS
Member +
中文
Weather Element
Air Temperature
Time
2017/01/01 10:00
Map
Satellite
Shenzhen
深圳市
Lam Tsuen Country Park
Tai Lam Country Park
Sai Kung West Country Park
Sai Kung East Country Park
Kau Sai Chau
Tsing Yi
Chek Lap Kok
Lantau Island
Hong Kong Island
Lamma Island
Google

# *Next Generation of Co-WIN*

## The need of next generation of Co-WIN

1. Existing Co-WIN AWS are proprietary systems. Data gathered are encrypted, can only be displayed on a dedicated PC software.

2. Prices of the hardware components not particularly low → implementation and maintenance cost not low → hinders its sustainability and expandability.

# *Co-WIN 2.0*

## Basic Requirement and Components Co-WIN 2.0 AWS

1. Built on an open-source electronics platform;
2. Modular in design with easy-to-use hardware and software;
3. Hardware, including measurement sensors, customizable and expandable by users, and readily available from the market;
4. No need for an operating system (minimize power consumption).

# *Co-WIN 2.0*

## Selected choice - Arduino

1. Cost effective

2. Core - Arduino microcontroller boards

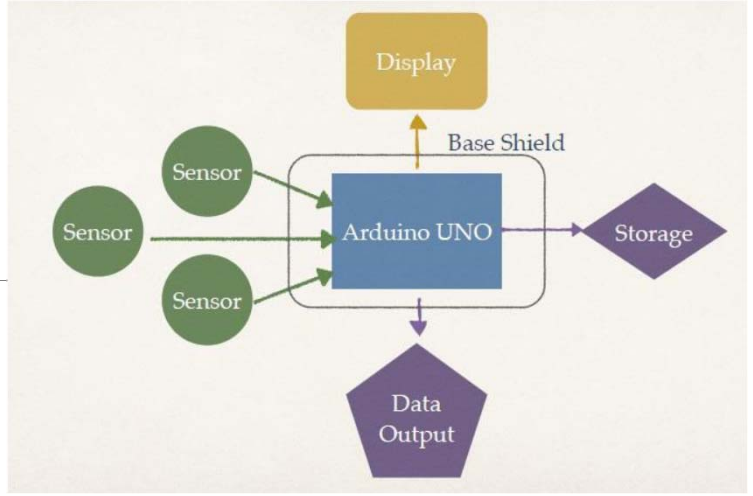
   (Arduino UNO: 14 digital input/output ports,

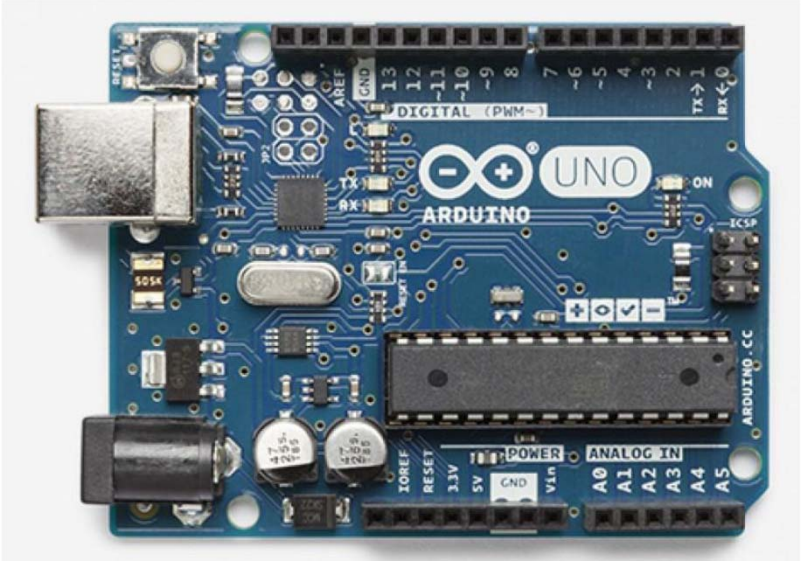
   6 analogue input ports)

3. Open-source software

   (Arduino Integrated Development Environment (IDE))

   Free on Windows, MAC, Linux

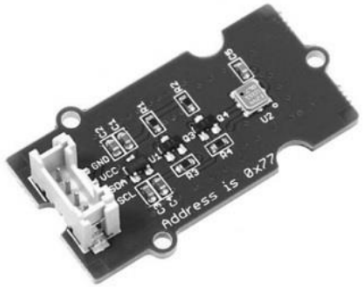


# *Co-WIN 2.0*

## Selected choice - Arduino

Available Sensors




# *Co-WIN 2.0*

## Arduino-based AWS (AB-AWS)

Typical AB-AWS on field :

1. T and RH sensor (model: DHT22)

| Measurement | range | accuracy |
|---|---|---|
| T | –40˚C to 125˚C | ± 0.5˚C |
| RH | 0% to 100% | ± 5% |

2. P sensor (model: BMP280)

| Measurement | range | accuracy |
|---|---|---|
| P | 300 to 1100hPa | ± 1 hPa |

Power: batteries charged by a solar panel

# *Co-WIN 2.0*

## Arduino-based AWS (AB-AWS)

Typical AB-AWS on field :

3. Rainfall

   specially designed, tipping bucket raingauge

4. Data transmission

3D-printing radiation shield and tipping bucket raingauge
(material: polylactic acid (PLA))

# *Co-WIN 2.0*

## Arduino-based AWS (AB-AWS)

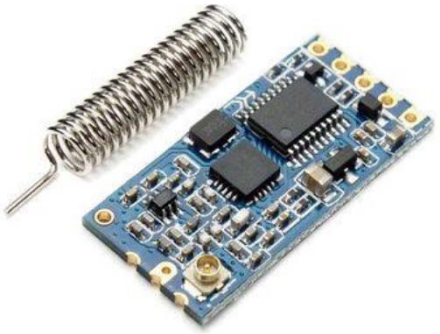
Typical AB-AWS on field :

3. Rainfall

   specially designed, tipping bucket raingauge

4. Data transmission

Arduino compatible GPRS modem



433 MHz RF Transceiver used in Co-WIN 2.0

# *Co-WIN 2.0*

## Promotion of Co-WIN 2.0 AWS

Training workshop (tie with world-wide education policy under STEM)

'Train-the trainer' and 'Do-It-Yourself' (DIY) approach

1. Sensor principles
2. Interfacing techniques
3. Programming
4. Sensor siting
5. Measurement limitation
6. Calibration of sensors

# *Discussion*

***Limitation***

1. Arduino UNO microcontroller board: only 32kB actual programmable memory

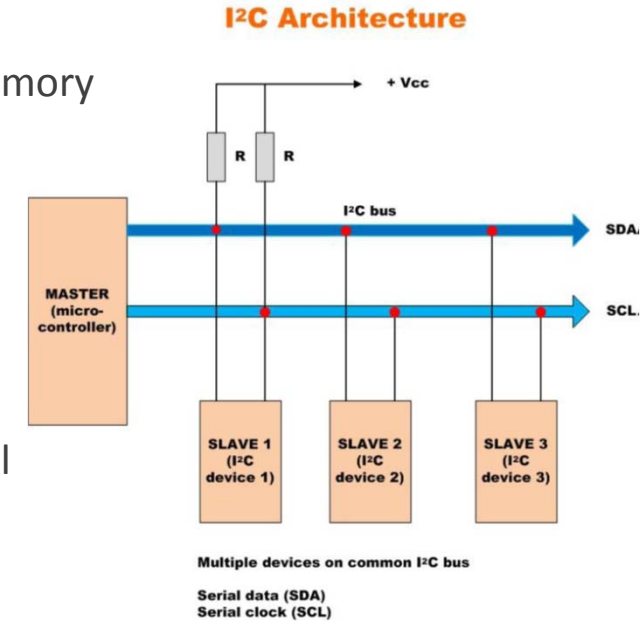
   ➡ simple setup to handle a limited no. of sensors

2. Arduino UNO microcontroller board: limited no. of input/output ports

   ➡ limited no. of sensors

3. Arduino UNO microcontroller board: supply up to 500 mA current in total

   ➡ need external power supply to drive extra external modules




I2C multi-master, multi-slave communication architecture

# *Discussion*

## ***Limitation***

4. Arduino: limited serial input/output ports

   ➡ issues when using GPS modules for location finding, storing data onto SD card or flash drives

5. Arduino UNO microcontroller board: no real time clock (RTC)

   ➡ hard to deploy for mobile use in conjunction with GPS module

Many of them can be overcome through external modules of GPS and RTC, or Arduino-like modules with onboard memories, etc.

# *Future work*

**Future work**

1. Implementation of wind sensors and a raingauge module
2. Equipment housing to safeguard from severe weather
3. Exploring better sensors, e.g. PT100 platinum resistance thermometer
4. Development of new prototype of miniature and low power smart weather sensors for urban weather monitoring

# *Future work*

**New prototype of miniature and low power smart weather sensors**