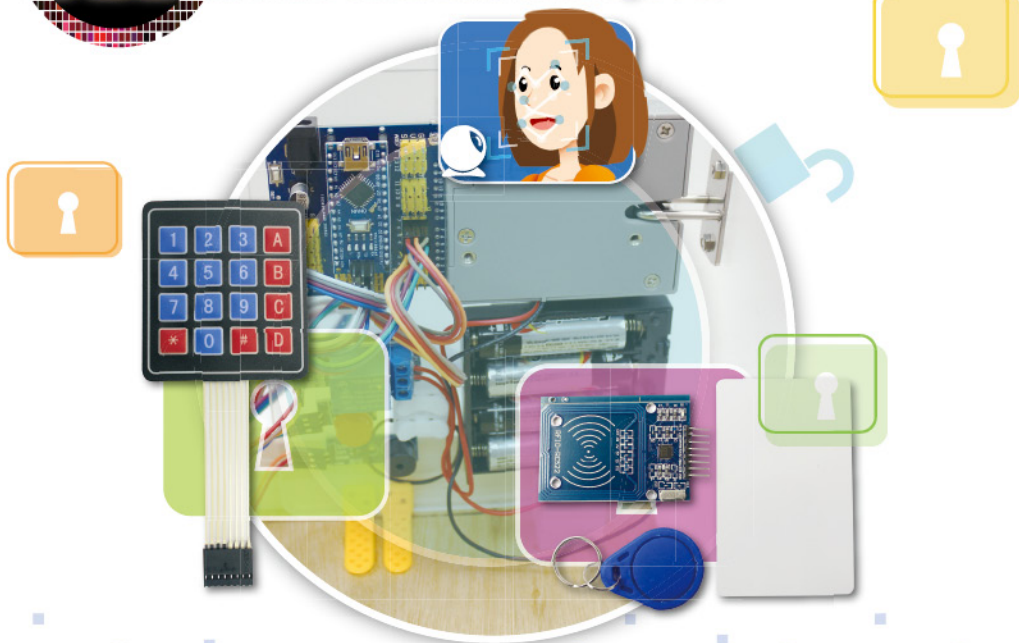# S T E M

Science　Technology　Engineering　Maths

AI 門禁系統教學套件
Access Control Teaching Kit

- 含豐富的軟硬件資源
  Rich in hardware and software resources
- 採用 Python + mBlock + Arduino 實作的方式
  With the implementation of Python, mBlock & Arduino
- 深入淺出地學習各項硬件原理和編程技巧的實際應用
  Learns the principles of hardware and the practical application of programming skills easily
- 教學材料採用開放源碼軟硬件
  Teaching materials are developed with open source hardware and software
- 教師可配合設計與科技科課程自訂教學內容及STEM教學活動
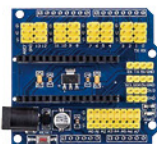 The teaching content and STEM learning activities can be customized to cater for the Design & Technology curriculum

雅博資訊科技有限公司
Apricot Information Technology Limited

目錄 Contents

主要零件 Key Parts

Arduino Nano 3.0 控制板 /
Arduino Nano 3.0 Control Board

Arduino Nano I/O 擴展板 /
Arduino Nano I/O Shield

I2C LCD1602 模組 /
I2C LCD1602 Module

MIFARE RFID-RC522 模組 /
MIFARE RFID-RC522 Module

6V 電磁閥門鎖 /
6V Solenoid Door Lock

4x4 薄膜鍵盤模組 /
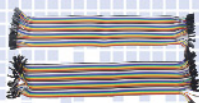4x4 Membrane Keypad Module

無源蜂鳴器模組 /
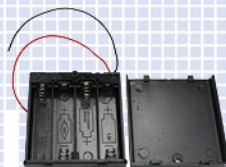Passive Buzzer Module

輕觸按鈕模組 /
Tactile Button Module

1 路 5V 繼電器模組 /
1-Channel 5V Relay Module

按壓式接線器 /
Push-in Wire Connector Holder
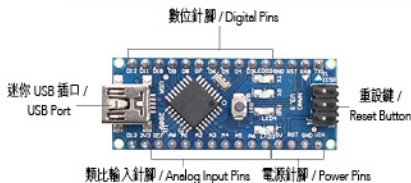
杜邦線 /
Jumper Wires

4 節 AA 電池盒 /
4-AA Battery Holder

Arduino Nano 3.0 控制板
Arduino Nano 3.0 Controller Board

數位針腳 / Digital Pins

迷你 USB 插口 / USB Port

重設鍵 / Reset Button

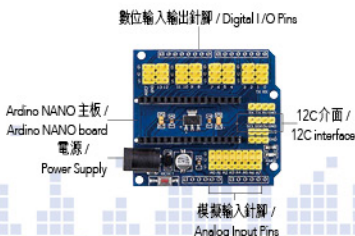類比輸入針腳 / Analog Input Pins　電源針腳 / Power Pins

Arduino Nano 是基於 ATmega328 的微處理器，可以直接應用在麵包板上。它具有與 Arduino UNO 相同的功能，但體積更小。它沒有直流電源插孔，並改用了迷你 USB 插頭。

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 microprocessor. It has the same functionality of the Arduino UNO, but in a much smaller package. It lacks only a DC power jack, and works with a Mini USB cable.

Arduino Nano I/O 擴展板
Arduino Nano I/O Shield

數位輸入輸出針腳 / Digital I/O Pins

Ardino NANO 主板 / Ardino NANO board
電源 / Power Supply

I2C介面/ I2C interface

模擬輸入針腳 / Analog Input Pins

Arduino Nano I/O 擴展板是專為 Arduino Nano 而設，方便連接各類感應器的多用途擴展板。擴展板支援直接使用跳線，而每個輸入輸出針腳都配備了 5V 和 GND，以方便連接感應器模組。擴展板有獨立的 I2C 介面以供 I2C 設備使用。擴展板更有獨立的供電模組，為感應器和摩打提供額外的電源。

The Arduino Nano I/O Shield acts as an expansion board for the Arduino Nano microcontrollers. The Shield supports jumper wires for rapid prototyping and each pinout includes 5V and GND pins for easy connection to sensors. It has an independent I2C interface for connecting I2C devices. It also has independent power supply to provide extra power for servo and other sensors.

I2C LCD1602 模組
I2C LCD1602 Module
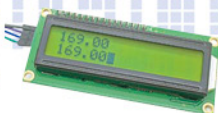
I2C LCD1602 模組能同時顯示兩行，每行 16 個，總共 32 個字符，其背光通常是黃綠色或者是藍色。

This is a basic 16 character by 2 line dot matrix display, usually comes with black text on green or blue background.

MIFARE RFID-RC522 模組
### MIFARE RFID-RC522 Module

RFID 讀取器 / RFID Reader

RFID 標籤 / RFID Tag

無線射頻識別 (RFID) 是一種通訊技術，通過無線電波的訊號─而非機械或光學接觸─識別特定的目標並讀寫相關的數據。它是由三大部分組成的：RFID 標籤、RFID 讀取器和 RFID 主控端，通常應用於身份識別、門禁與防盜系統等。

Radio Frequency Identification (RFID) is a communication technology that identifies certain targets, reads and writes data transmitted by radio waves without mechanical or optical contact. It has three main components: RFID tag, RFID reader and RFID terminal. It is widely used for human identification, access control and anti-theft systems, etc.

6V 電磁閥門鎖
6V Solenoid Door Lock
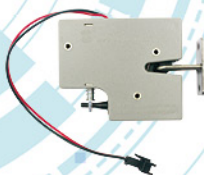
電磁閥門鎖的使用方法是當使用者透過輸入密碼、拍感應卡或掃描面部特徵來認證身份，認證成功後，電磁閥門鎖就會通電而解鎖。電磁閥門鎖廣泛應用於儲物櫃、寄存櫃、自動售賣機等。

The usual operation of solenoid door lock involves ID identificatione by typing in a password, tapping a smart card or scanning the facial features. When the authentication is successful, the solenoid door lock will be powered and unlocked. It is commonly used in lockers, storage cabinets, vending machines, etc.

4x4 薄膜鍵盤模組
4x4 Membrane Keypad Module

薄膜鍵盤是種矩陣鍵盤，有不同的矩陣格式，其中 4x4 和 4x3 較為普遍。以 4x4 薄膜鍵盤模組為例，它共有 16 個鍵，每個鍵的下方有一個薄膜開關，它們彼此之間有一個在底部的 4x4 可導電矩陣線連繫着，使按下時電流可在它們之間通過。

Membrane keypads are matrix keyboards having different matrix sizes, the more prevalent ones being 4x4 and 4x3. A 4x4 membrane keypad module, has 16 keys. Beneath each key is a membrane switch connecting to other keys through a 4x4 conductive matrix circuit under the pad, which allows current to flow among them when pressing the keys.
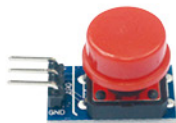
無源蜂鳴器模組
Passive Buzzer Module

蜂鳴器是可以產生聲音的信號裝置，有機械型、機電型及壓電型。我們可以控制無源蜂鳴器的音高，從而用它來播放音樂。

A buzzer is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. You can control the sound frequency of a passive buzzer and play music on them.

輕觸按鈕模組
Tactile Button Module

輕觸按鈕模組是開關的一種。當其被按下時，電路就會接通。當其被釋放時，電路就會斷開。輕觸按鈕模組常見於接鍵，例如電腦鍵盤和滑鼠。

Tactile button module is a special kind of switches. Usually, it is closed when pressed and it is opened when released. Tactile button module is commonly used in keys or buttons such as computer keyboards and mouse devices.

1 路 5V 繼電器模組
1-Channel 5V Relay Module

繼電器是一種用較小的電流去控制較大電流的一種「自動開關」，它可以讓我們控制原本 Arduino 主板控制不了的裝置。1 路繼電器模組是指它只可以控制單一組電路的開關。

Relays can be used to control high voltage devices which cannot be powered directly from Arduino boards. A one-channel relay module can only control one device at a time.

編程語言 Coding Language

Scratch 程式語言是由 MIT 開發的免費教學用程式語言，特別為中小學生而設計。Scratch 使用圖形化的積木編程界面，簡單易用。

參考書目：① PA01s Scratch 3.0 初階；② PA02s Scratch 3.0 進階

Scratch is a free educational coding language developed by MIT and geared towards kids aged 8 to 16. Scratch's drag-and-drop programming blocks can fit into one another like jigsaw puzzle pieces.

Reference Books: ① PA01s Scratch 3.0 : Basic Skills; ② PA02s Scratch 3.0 : AdvancedSkills

產品特色 Product Features

1. **詳盡自學教程 Detailed Self-Learning Tutorial**
   - 教學內容詳盡，鼓勵同學自學。
     Detailed teaching and learning materials are provided to facilitate students' self-learning.
   - 充足及清晰指引以提升學生學習效率。
     Adequate and clear instructions are given to enhance students' learning efficiency.
   - 教程支援電腦、平板及智能手機，方便易用。
     Tutorial supports different devices including computers, tablets and smartphones.

2. **Scratch 語言教學 Scratch Programming Language**
   - 採用流行、簡易並免費的 Scratch 程式語言來進行教學，學與教更簡便。
     Scratch, a popular, simple and free programming languages is used, which makes learning and teaching easy.
   - 特別加入與硬件相關的編程技巧。
     Hardware-related programming skills are covered.

3. **開放源碼的軟硬件 Open-Source Software & Hardware**
   - Python、Arduino 和 mBlock 都是開放源碼的，教師可以按校本需要調整內容。
     Python, Arduino and mBlock are open-source. Teachers can adjust the teaching content according to school needs.

教材和學材 Teaching and Learning Materials

1. **基礎知識 Basic Knowledge**
   - 附多本基礎知識教程，即使完全不懂 mBlock 和組裝機械，也能輕鬆學習。

   Basic knowledge tutorials of mBlock and robot assembly are provided for beginners.

2. **自學教材 Self-Learning Guide**
   - 每個專案都有詳盡的自學教材，鼓勵自主學習。

   Each project contains detailed self-study materials in order to encourage self-study.

3. **資源檔案及建議答案 Resource Files & Suggested Answers**
   - 全部與編程有關的作業均配備相關的資源檔案及建議答案。

   All assignments related to programming are provided with relevant resource files and suggested answers.

4. **工作紙 Worksheets**
   - 提供與專案相關的工作紙，附計分指引和答案，方便鞏固知識和評核。

   Project-related worksheets are provided with marking scheme and answers to facilitate knowledge consolidation and assessment.

5. **互動光碟及專用網站 Interactive CD-ROM & Companion Website**
   - 光碟和網站均提供完整的教材和學材，方便備課、教學或自學。

   A CD-ROM and a website with full teaching and learning materials are provided. (網址 Website：http://www.apricot.com.hk/stemkit/)

專案一：製作按鍵鎖
Project I: Creating a Keypad Lock

同學可以先從基礎知識小冊子了解 4x4 薄膜鍵盤模組和 I2C LCD1602 模組的運作原理，它們是按鍵鎖的重要組件。然後透過 Arduino Nano 板連接所需零部件和電源來組裝按鍵鎖，並上傳 mBlock 程式以測試按鍵鎖開啟電磁閥門鎖。

Students can first learn about the operation principles of the 4x4 Membrane Keypad Module and I2C LCD1602 Module from the basic knowledge booklets. They are main components of the keypad lock. Then, using the Arduino Nano board in connecting all needed components and power supply and uploading the mBlock program, students can try to unlock the solenoid door lock with the keypad.
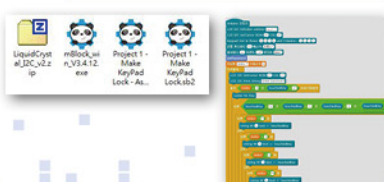
專案資源 Project Resources

自學教材
Self-Learning Guides

資源檔案
Resource Files

動手做指引 / 工作紙
DIY Guides / Worksheets

建議答案
Suggested Answers

專案二：製作智能卡鎖
## Project II: Creating a Smart Card Lock

同學可以先從基礎知識小冊子了解 MIFARE RFID-RC522 模組的運作原理，它是智能卡鎖的重要組件。然後透過 Arduino Nano 板連接所需零部件和電源來組裝智能卡鎖，並上傳 mBlock 程式以測試智能卡鎖開啟電磁閥門鎖。

Students can first learn about the operation principle of the MIFARE RFID-RC522 Module from the basic knowledge booklets. It is the main component of the smart card lock. Then, using the Arduino Nano board in connecting all needed components and power supply and uploading the mBlock program, students can unlock the solenoid door lock with smart cards.

專案資源 Project Resources

自學教材 Self-Learning Guides
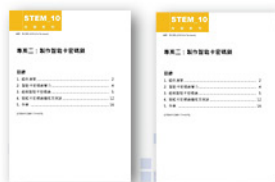
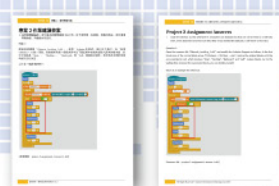

資源檔案 Resource Files

動手做指引 / 工作紙 DIY Guides / Worksheets

建議答案 Suggested Answers

專案三：製作面部辨識門禁系統
## Project III: Creating a Face Recognition Access Control System

　　同學可以先從基礎知識小冊子了解軟件 Anaconda 和 OpenCV 的應用和面部辨識的 AI 原理，它們被使用於面部辨識門禁系統。然後透過 Arduino Nano 板連接所需零部件和電源來組裝電路，並使用 Python 和 Anaconda 程式以測試面部辨識開啟電磁閥門鎖。

　　Students can first learn about the software Anaconda and OpenCV and the AI principle of face recognition used the face recognition access control system. Then, using the Arduino Nano board in connecting all needed components and power supply, as well as Python and Anaconda programs, students can unlock the solenoid door lock by face recognition.
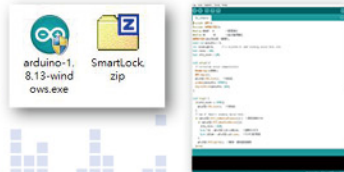
專案資源 Project Resources

自學教材
Self-Learning Guides

資源檔案
Resource Files

arduino-1.8.13-windows.exe　　SmartLock.zip
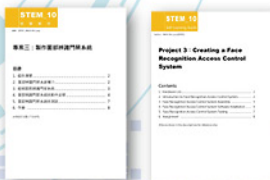
動手做指引 / 工作紙
DIY Guides / Worksheets

建議答案
Suggested Answers

本教學套件為配合教育局推行的STEM教學而設計，適合中小學生使用，學與教材料齊備，方便作課堂教學、專題研習或自主學習之用。

產品特色 Product Features

- 開放源碼的軟硬件 Open-Source Software & Hardware

- 詳盡自學教程 Detailed Self-Learning Tutorial

- 採用Scratch語言教學 Scratch Programming Language for Teaching

- 提供活動相關的基礎知識 Related Basic Knowledge Provided

- 資源檔案及建議答案 Resource Files & Suggested Answers

- 工作紙 Worksheets

- 動手做指引 DIY Guides

- 互動光碟及專用網站 Interactive CD-ROM & Companion Website

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