嗇色園主辦可銘學校 網上電子科學家 課堂筆記







導師: 甯幹英 日期: 2021年10月

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1. 課程概覽

STEM 是態度的培養,也是技術的鍛鍊,亦是知識的學習。本校的 STEM 以電子科技為主導。為甚麼本校把大學的電子科技課程運用到小學的課程去?日常的科技產品,可說是電子科技的世界,電子科技與程式的運用更是人工智能(Artificial Intelligence)的基礎。為了讓本校學生容易學習電子科技,本校把電子科技分為四大範疇:

❶電子元件

- 2電子線路圖
- ₿程式編寫
- **④**作品組裝

本課程首先概述閉合電路、電的功用、Arduino Mega 2560、PictoBlox 和雙色及三色電線,然後介紹學生學習 LED、蜂鳴器、可變電阻、伺服馬達、溫濕度感應模組、超聲波模組、馬達和按鈕。透過第一至第九課的實踐,學生便可學習到電子元件、電子線路圖和程式編寫。最後,學生接受大挑戰。他們需要學以致用,把學習過的知識和技術,自行創作一件作品。這就是作品組裝,也是他們第一件創作作品。這同時發揮了他們創意能力,也展現了他們的解難能力。這小學化的大學電子科技課程是本校 STEM 教育的一個特色。

2. 閉合電路

閉合電路包括了電源、電線和負載。乾電池和鋰電池是常用的電源。電線多是銅線,它 是常用的導電體,外層被塑膠包裹着。紅色的電線是正極,黑色是負極。LED、蜂鳴器和 馬達等是常用的負載,我們接駁電路,目的就是要為我們工作。最後能為我們工作的電 子元件就是負載。

在使用 Arduino Mega 2560 設計電路中,假如我們想同時亮起 LED 和響起蜂鳴器,這表示 它包涵了三個閉電路:



① Arduino Mega 2560 (這個閉合電路啟動了 Arduino 功能, Arduino 才能為我們工作)

②LED 及蜂鳴器(這兩個閉合電路分別使 LED 亮起來和使蜂鳴器響起來)



因此,我們必須緊記:當我們想任何一種電子元件(LED、蜂鳴器、馬達、超聲波、溫濕度感應等)為我們工作,它們在 Arduino Mega 2560 的電路裏,必須是一個閉合電路。

3. 電的功用

電分為正極電源和負極電源。它有兩種功用:

①大電流的正負極電源:它能驅動 LED、蜂鳴器和馬達等。
 ②小電流的正負極電源:它只是一個信號源,不能驅動 LED、蜂鳴器和馬達等,但這個信號源(小電流)能叫醒大電流為我們工作。

4. Arduino Mega 2560

4.1 功能簡介



Arduino Mega 2560 是 Arduino 的其中一個板子, Arduino 還有 Arduino Uno、Nano 等數十種。它的工作電壓是 5V。它的運算處理器是 ATmega2560。它有 54 個腳位,這 54 個腳位可以用作輸入,也可以用作輸出。從輸入腳位接收到信號後,例如,使用 者按下按鈕(輸入信號), ATmega2560 開始運算,最後控制輸出,例如:亮起 LED。因此,使用者按下按鈕,LED 便亮起來。

Arduino Mega 2560 是一個小型電腦,它包涵了輸入、運算處理和輸出。

4.2 電源

它的工作電壓是 5V。Arduino Mega 2560 有兩個供電插頭:

①USB 插頭



@5.5mm/2.1mm 直流電源插頭



擴展板已插在 Arduino Mega 2560 的上面

4.3 數碼腳位、PWM 腳位及模擬腳位

Arduino Mega 2560 有 54 個腳位,它們可以用作輸入腳位,也可以用作輸出腳位。這 54 個腳位當中有 15 個可以用作 PWM 輸出腳位及 16 個模擬輸出腳位。

4.4 重置按鈕

這是重置按鈕,按下便可把程式從新再執行:



4.5 擴展板

這是 MEGA Sensor Shield 專用感測器擴展板。



它主要的功用是引出了多個正極(V)和負極(G),而原來的 54 個腳位便成為了擴展板上的信號腳位(S)。 (繪圖表示)

4.6 怎樣與電腦溝通

下載線是電腦與 Arduino Mega 2560 的溝通橋樑。它除了為 Arduino Mega 2560 提供 電源之外,還擔起了兩者溝通的橋樑。



- 5. PictoBlox
 - 5.1 功能簡介

PictoBlox 由 STEMpedia 發行。它沿用 Scratch 介面,以拖拉程式方塊建立程式。它除 了能建立圖像程式(遊戲程式)外,還可以把拖拉好的程式方塊實時轉換為 Arduino 程 式,並能把相關程式寫進 Arduino 的板子裏,讓 Arduino 執行程式,驅動電子元件。

- 5.2 如何下載
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5.3 如何安裝

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6. PictoBlox 成功安裝後,開啟便出現如下的介面



※以後只要在桌面以滑鼠左鍵連按兩次這個圖示,便可開啟 PictoBlox



5.4 版面介紹



5.5 Stage 模式

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😴 Code 🥒 Costumes 📢 Sounds		う で 🍋 🗾	🗘 Upload Firmware
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Sensing go to x: 0 y: 0 and a sensing a sensing	此區城口金		
Operators glide 1 secs to random position •	山田国伯		
Variables glide 1 secs to x 0 y 0	 山况回家		
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			Backdrops
change x by 10	· · · · · · · · · · · · ·		
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5.6 Upload 模式

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Arduino Mega Control Operators Vansables Vansa	以滑鼠按下 Upload 模式		<pre>1 //This arduino code is gene 2 void setup() { 4 //put your setup code her 5 6 7 } 8 9 void loop() { 10 //put your main code here 11 12 14 14 15 15 15 16 17 16 17 17 17 18 18 18 19 19 10 10 10 10 10 10 10 10 10 10 10 10 10</pre>	erated by PictoBlox re, to run once: e, to run repeatedly:
Arduno Mega Consort Actuators Sensor	此區顯示 程式文字		14	
Display Modelan Dabbie Dabbie		0	>> Log 🚓 Serial Monitor	
Cost 15.5 to infoger	at 💽 🖬 🚖 🗲	= 5 <u>1</u> &	👔 🌙 30°C 🛆 🖻 🕊	<i>慌</i> 4× 英 督 21:39 □

●把 Arduino Mega 2560 板子插上 USB 電線,再接上電腦

- ❷選取 PictoBlox 的 Board , 選取 Arduino Mega
- ❸選取 PictoBlox 的 Connect , 選取 Connect
- ❹選取 PictoBlox 的 Upload Mode

- 6. 物料介紹
 - 6.1 Arduino Mega 2560



6.2 Arduino Mega 2560 擴展板



6.3 程式燒錄線



6.4 紅色 LED



6.5 黃色 LED



6.6 綠色 LED



6.7 可變電阻



6.8 伺服馬達、轉軸、小鑼絲







6.9 溫濕度感應模組



6.10 超聲波模組



6.11 馬達



6.12 扇葉



6.13 按鈕



6.14 有源蜂鳴器



6.15 無源蜂鳴器



6.16 紅外線發射器



6.17 紅外線接收器



6.18 模擬光感應器



6.19 光敏電阻



6.20 銅柱



6.21 三色電線



6.22 雙色電線



7. 插線和擴展板

7.1 插線

7.1.1 電子元件插線





7.1.2 擴展板插線



7.2 擴展板

7.2.1 數碼腳位



在擴展板上,直看時,見到的數字表示數碼腳位,如第12、10…19腳; 橫看時,見到的「S」是信號源、「+5」是正極電源、「G」是負極電源

7.2.2 模擬腳位



在擴展板上,直看時,見到的字母加數字表示摸擬腳位,如第 A1…A0 腳; 橫看時,見到的「S」是信號源、「+5」是正極電源、「G」是負極電源

8. 第一課:LED

8.1 紅色 LED

線路圖

實物圖





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	Arduino Meg	a										 //This arduino code is generated by PictoBlox 2
erators	T.com when /	Arduino Mega s	tarts up									<pre>3 * void setup() { 4 //put your setup code here, to run once: 5 pinMode(2, OUTPUT);</pre>
iables	T and sound	etatue of cligita	Loin 12 -		1000	when Ardu	ino Mega starts up					6 7 8 }
		status of digita	rpiir 13 -		forever							9 10 - void loop() {
Blocks	1.001 read a	analog pin A0			1.00	set digita	il pin 🛛 👻 output :	as HIGH 🕶				<pre>11 //put your main code here, to run repeatedly: 12</pre>
tuino ega	set dig	ital pin 13 🝷	output as HIG			-						13 14 digitalWrite(2, true); 15 }
) Jators	set PW	/M pin 13 🔻	output as 255									16
Isors	nav to	ne on 46 👻	of note C2 💌									
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2010S		get timer value									1	child process exited with code Ochild process exited with
bble	reset ti	mer								0		code U
										C		

8.2 紅色和黃色 LED





實物圖



程式

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Bensors Display Modules Dabble	I See Play 1 I See Tresot I See Cast	get timer timer 15.5 to 50 fro	o integer m 0	note C2 - - 255 to				 	· · · · · · · · · · · · · · · · · · ·			>> Lo child p code 0	ng Process	◆ Serial Monito exited with	r code Oci	hild pro	ocess e	cited w	vith
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8.3 紅色和黃色 LED 同時一閃一閃



8.4 小小任務

怎樣使紅色、黃色和綠色 LED 同時一閃一閃?

9. 第二課:有源蜂鳴器

9.1 蜂鳴器長響

線路圖



實物圖



程式



9.2 斷斷續續的蜂鳴器





9.3 小小任務

怎樣使紅色 LED 亮起兩秒,接着蜂鳴器響起兩秒?

10.1 可變電阻的工作原理



10.2 如要使用 Serial Monitor(電腦與 Mega 溝通),步驟如下:

BLOX File Edit Tutoria	Is Board Connect 💉 VY		
Control		•) C (*) X Subaction 1 ///file and/act code is generated by Pictolice • vedi satu() (• vedi satu() (code) here, to run ance:	溝通後,可變電阻的數據
nepadi 😨	vition Archino Mega starts up 4* set sostal 0 + basid rate to 00	<pre>9 } 10 11 void loo() { 11 void loo() { 13 v//nd your main code here, to run repeatedly 13 v//nd your main code here, to run repeatedly 13 v//nd your main code here, to run repeatedly 14 v//nd your main code here, to run repeatedly 15 v//nd your main code here, to run repeatedly 15 v//nd your main code here, to run repeatedly 15 v//nd your main code here, to run repeatedly 15 v//nd your main code here, to run repeatedly 15 v//nd your main code here, to run repeatedly 15 v//nd your main code here, to run repeatedly 15 v//nd your main code here, to run repeatedly 15 v//nd your main code here, to run repeatedly 15 v//nd your main code here, to run repeatedly 15 v//nd your main code here, to run repeatedly 15 v//nd your main code here, to run repeatedly 15 v//nd your main code here, to run repeatedly 15 v//nd your main code here, to run repeatedly 15 v//nd your main code here, to run repeatedly 15 v//nd your main code here, to run repeatedly 15 v//nd your main code here, to run repeatedly 15 v//nd your main code here, to run repeatedly 16 v//nd your main code here, to run repeatedly 17 v//nd your main code here, to run repeatedly 18 v//nd your main code here, to run repeatedly 18 v//nd your main code here, to run repeatedly 19 v//nd your main code here, to run repeatedly 19 v//nd your main code here, to run repeatedly 19 v//nd your main code here, to run repeatedly 19 v//nd your main code here, to run repeatedly 19 v//nd your main code here, to run repeatedly 19 v//nd your main code here, to run repeatedly 19 v//nd your main code here, to run repeatedly 19 v//nd your main code here, to run repeatedly 19 v//nd your main code here, to run repeatedly 19 v//nd your main code here, to run repeatedly 19 v//nd your main code here, to run repeatedly 19 v//nd your main code here, to run repeatedly 19 v//nd your main code here, to run repeatedly 19 v//nd your main code here, to run repeatedly 19 v//nd your main code here, to run repeatedly 19 v//nd your main code here, to run repeatedly 19 v//nd your main code here, to r</pre>	便可在此顯示
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i then		>> Log	ef vito
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以滑鼠按 * * * * * * * * * * * * * * * * * * *	此圖示 Internet of Things (ioT) Connet provide the good	ee an Extension Data Legger Store data in CEV File.	2 ×
以滑鼠按 * * * * * * * * * * * * * * * * * * *	此圖示 Internet of Things (ioT) Connect protects along the gooder	ee al Extension Date Legger Store data in CBV File: Store data in CBV File: Rebolic Arm (4-axis) Program your Ricbolic Arm (4-axis).	
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❷以滑鼠按此圖示(Communication)

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	87 Co	de							5 C 🖗	Upload Code
Control Operators	Control	oconds								<pre>1 //This arduino code is generated by PictoBlox 3* wold setup() { //put your setup code here, to run once: Serial.begin(9600); 6 pinNode(0, INPUT); 7</pre>
Variables My Blocks	Recever.	9					ethen Arthuin aut sorial	no Mega starts: up 0 + baset rate to \$600 +		<pre>3 } 11 = void loo() { //put your main code here, to run repeatedly: //put your main code here, to run run repeatedly: //put your main code here, to run run run run run run run run run run</pre>
Actuators		ع then				Server ++ wat	write 🗧		arial 0 -	<pre>15 Serial.println(analogRead(0)); delay(0.1 * 1000); 17 </pre>
Display		these					ر			>> Log 📌 Serial Monitor
Communication	eter vezt szti									ild process exited with code Ochild process exited with $d\sigma = 0$
=	repeat until									946

❸以滑鼠按此圖示(Communication)



④現在可拖拉相關程式方塊







實物圖



程式

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erators	Arduino Mega	starts up						<pre>1 //This andwino code is generated by PictoBlox 2 void satup() { //out your satup code here, to run once: pinMode(0, IMPUT); pinMode(3, OuTPUT); </pre>
Blocks	2000 read status of dig 2000 read analog pin 2000 sot digital pin	tal pm 13 +			en Arduino I	Moga starts up		<pre>> } " void loop() { //put your main code here, to run repeatedly: //put your main code here, to run repeatedly: seesd(0), 0, 255, 0, 1023) </pre>
uators	set PWM pm 13 -	output as 255			3			
splay dules	play tone on 46 •	of noto C2 •						>> Log 40* Serial Monitor
x bble	2000 reset timer							code 0
iumcati (D)	155 to 1	nteger -						

10.4 小小任務

怎樣利用可變電阻調較蜂鳴器的聲量?

11. 第四課: 伺服馬達

11.1 伺服馬達使用時要注意的地方



它是逆時針旋轉的

11.2 伺服馬達設置在0度











11.3 伺服馬達逆時針轉動



實物圖







🍯 PictoBl	ox							- o ×
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Control Operators Variables My Blocks Arduators Arduators Sensors Display Modules	Control wall 1 seconds repeat 10 forever forev			hon Arduno Mega star I servo on 2 • 10 seconds set servo on 2 • 1 seconds set servo an 2 • 1 seconds			1 2 3 4 5 6 7 8 9 10 11 11 12 13 14 15 16 17 19 20 21 31 32 34 5 5 5 5 5 5 5 5 5 5 5 5 5	<pre>//This arduino code is generated by PictoBlox //Include Libraries #include <servo.h> //MACROS are defined here Servo2; void setup() { //put your setup code here, to run once: Servo2.attach(2); Servo2.write(0); delay(3 * 1000); } void loop() { //put your main code here, to run repeatedLy: Log</servo.h></pre>
=	wait until						a) =	
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11.4 伺服馬達順時針轉動



實物圖









11.5 小小任務

伺服馬達最大能轉動的角度是多少?

12. 第五課:溫濕度感應模組

12.1 在電腦受幕顯示溫度

線路圖

實物圖







🍯 PictoB	lox																		_	o ×
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Control Operators Variables My Blocks Arduino Mega Actuators Control	Control weat 1 set repeat 10 forever	econds J				when Arc set serial over write vait 0.1 set	tuino Moga	starts up aud rate to 90	6 ● from [DHT sensor	at pin 2	on se	1 2 3 4 5 6 7 8 9 9 10 11 12 13 14 15 16 17 18 19 20 0 21	<pre>//Thi //Inc #incl //MAC #defi #defi DHT d //p Ser dht } void //p </pre>	s arduir. Luded Li ude <dht ROS are ne DHTPI ne DHTTY. ht_2(DHT setup() ut your lial.begi _2.begir loop() { ut your</dht 	no code n braries .h> defined N_2 2 PE DHT11 PIN_2, [{ setup cc n(9600); (); main cod	is genera here DHTTYPE) ode here,	ated by ; , to rur to run	PictoBlc n once: repeated	ικ 1Ly :
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12.2 在電腦受幕顯示濕度





🍯 PictoBl	ox						- 0 ×
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	See Code				5 6	X Upload Code	
Control Operators Variables My Blocks	Control wat 1 seconds ropoat 10 forever		torver when Adduno I ←→ set smitl 0 torver	Ange slarts up baud rate to 9600 • get humidity • from D4	ff sensor at pn 2 +) on sortal	<pre>1 //This arduino code is generated by Picto 2 //Included Libraries 4 #include ChTLn> 5 6 //MACROS are defined here 7 #define DHTTYPE DHT11 9 DHT dht_2(DHTTN_2, DHTTYPE); 10 11 void setup() { 12 //put your setup code here, to run once 13 Serial.begin(9500); 14 dht_2.begin(); 15 16 17 17 17 17 17 17 17 17 18 18 19 19 19 19 19 19 19 19 19 19 19 19 19</pre>	:
Actuators Sensors	if then		wait 0.1 second			<pre>16 17 18 18 19 void loop() { //put your main code here, to run repea 21 </pre>	tedly:
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Dabble	else					code 0	
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12.3 小小任務

怎樣在電腦受幕同時顯示溫度和濕度?

13. 第六課: 超聲波模組

13.1 在電腦受幕顯示超聲波所測的距離

線路圖



實物圖





🌝 PictoBl	ox					– 0 ×
Pict	BIOX File Edit	Tutorials Board	Connect 💉	ultrasound	8	Mode Stage Upload 🗈 🏟 🖶 🏹 Sign In
	🚝 Code				» ۲ C	1 Ipload Code
Control	Arduino Mega					1 //This arduino code is generated by PictoBlox 2 3 //MACROS are defined here
Operators	when Arduino Mega starts	up a a a a				<pre>4 * float getDistance(int trig,int echo){ 5 pinMode(trig,OUTPUT); 6 digitalWrite(trig.LOW)</pre>
Variables	read status of digital pin	13 -	when Arduino Mega	starts up		<pre>delayMicroseconds(2); delayMicroseconds(2); digitalWrite(trig,HIGH); digitalWrite(trig,HIGH);</pre>
My Blocks	read analog pin A0 🗸		→ set serial 0 be	ud rate to 9600 ▼		<pre>10 delaymin-rosecond(L0); 10 digitalWrite(trig,L0W); 11 pinMode(echo, INPUT); 11 pinMode(ec</pre>
Arduino Mega	set digital pin 13 - out	put as HICH	ever 👔 👔	t ultrasonic sensor distance (c	m) trig 2 🔹 , echo 3 💌	<pre>12 return pulseln(ecno, HiGH)/58.0; 13 } 14 15 * void setup() {</pre>
O Actuators	set PWM pin 13 ▼ outp	put as 255	wait 0.5 seconds			<pre>16 //put your setup code here, to run once: 17 Serial.begin(9600); 18</pre>
Sensors	nav tone on 46 = of n	ale C2 = 1				19 20 }
Display						>> Log +* Serial Monitor
Modules	get timer value					Input > 9600 > No lin >
Dabble	TLOS reset timer					13.24 13.53 13.40
Communicati (U)	icee cast 15.5 to integer					13.48 13.38 13.48
s:	map 50 from 0 ~	255 to				13.38 13.48 13.09
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13.2 小小任務

超聲波模組怎樣驅動 LED 和伺服馬達?

14.1 馬達向前轉動

線路圖





程式



14.2 馬達向後轉動

線路圖

實物圖



程式

Citt					<u> </u>							
	Ser Code									") ("		X Upload Code
rol tors	Arduino Mega	rts up	1.001	when Ardu	ino Mega s	starts up					1 2 3 4 5 6	//This arduino code is generated by PictoBlox //Included Libraries #include <motor.h> //MACROS are defined here</motor.h>
oles	read status of digital p	bin 13 -		connect m r	otor 1 •	direction	1 2 • dir reverse •	rection 2 3	• & PW	M 5 -	8 9 10 11 12	<pre>wotor Nator1(2, 3, 5); void setup() { //put your setup code here, to run once: }</pre>
ino ga tors	set digital pin 13 •	output as HIC H			2 		· · ·	 			14 15 16 17 18	<pre>void loop() { //put your main code here, to run repeatedly: Motor1 moveMotor(-2 55188):</pre>
ors lay les	play tone on 46 - o	of note C2 🔹 a									20	Log 4-* Serial Monitor
le I	get timer value											
5	cast 15.5 to intog	por - 255 to										

14.3 小小任務

怎樣以超聲波測距控制馬達轉動?

15.1 按鈕驅動一盞 LED

線路圖



實物圖



程式			
🍪 PictoBlox			- 0 ×
PictoBlox File Edit Tutori	ials Board Connect 💉 buttonLed	8	Mode Stage Upload ! 🂠 🌐 🗸 🤯 Sign In
Code		5 C 4	b D Upload Code 1 //This arduino code is generated by PictoBlox
Control Coperators	2.091 when Arduino Mega starts up		<pre>2 3 * void setup() { //put your setup code here, to run once: pinMode(2, INPUT); pinMode(4, OUTPUT); </pre>
Variables read status of digital pin 13 - My Blocks read analog pin A0 -	forever		<pre>9 9 } 10 void loop() { 12 //put your main code here, to run repeatedly: 12 </pre>
Arduino Moga Come set digital pin 13 • output as Arduino Moga Come set PWM pin 13 • output as	HIC eter 255 Image: Set digital pin 4 output as LOW •		<pre>13 14 15 * if(digitalRead(2)) { 16</pre>
Sensors play tone on 46 • of note C Display Modules	22 • 1 		20 } Log 4* Serial Monitor
Dabble			hild process exited with code Ochild process exited with ode O
Image: cast 15.5 to integer - Image: cast 15.5 <) 10		
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15.2 小小任務

怎樣以按鈕驅動伺服馬達?

16. 第九課:光敏電阻

16.1 光敏電阻在電腦受幕顯示數值

Maga S + 5 G LIII De Vac Que Ao



程式



線路圖

實物圖

16.2 光敏電阻驅動蜂鳴器





實物圖



程式

🧐 PictoBlox			- 0 ×
PictoBlox File Edit Tutorials	Board Connect 🚿 photoResistorBuzzer	8	Mode Stage Upload 🖪 🏟 🗰 🕈 🎯 Sign In
Second Code		5 6 4 8	K Lupload Code
Arduino Mega		1	//This arduino code is generated by PictoBlox
Operators	when Ardumo Mega starts up	3 • • 4 5 6 7	<pre>void setup() { //put your setup code here, to run once: pinNode(A0, INPUT); pinNode(2, OUTPUT);</pre>
Variables read status of digital pin 13 -	forever and the second se		X.
My Blocks read analog pin A0 •	read analog sensor light / photoresistor • a	at A0 • < 600 then 0 1 • .	<pre>void loop() { //put your main code here, to run repeatedLy:</pre>
Arduino Mega	aller sol agrae pri 2 • output as mon •	13 14 5 •	if((analogRead(A0) < 600)) {
Actuators set PWM pin 13 - output as 255	set digital pin 2 • output as LOW •	16 17 8 •	<pre>digitalWrite(2, true); } else {</pre>
Sensors		20	<pre>digitalWrite(2, false); }</pre>
Display Modules		>1 >1 >1	Log 🔶 Serial Monitor
co get timer value		child	process exited with code Ochild process exited with
Dabble reset timer		(Q)	
Communicati			
(U) cast 15.5 to integer -		a a	
map 50 from 0 - 255 to		(=)	
日 夕 在這裡輸入文字來搜尋 日	目 💽 🚞 🛸 🖇 🧕	🛯 🔟 🥸 🧕 🖉	梦 🕜 🐟 33℃ ヘ 📼 ╔ 邻 英 🖻 12:36 🖣

16.3 小小任務

怎樣以光敏電阻驅動馬達(50%速度)向前轉動?

17. 第十課:大任務

- 17.1 生活上你遇到甚麼困難,可以運用所學解決問題?
- 17.2 別人在生活上遇到甚麼困難,可以運用所學協助他/她解決問題?