www.M5Stack.com

Shenzhen Mingzhan Information Technology Co.,Ltd
RM106, Block A, MingLiang Technology Park, Zhuguangbei Road, Nanshan, Shenzhen, China.
E-mail: Support@m5stack.com

M5STICK

M5STACK

M5StickC

Developing IoT applications with ESP32 for Beginners

Revolutionary All-in-One Compact IoT Solution

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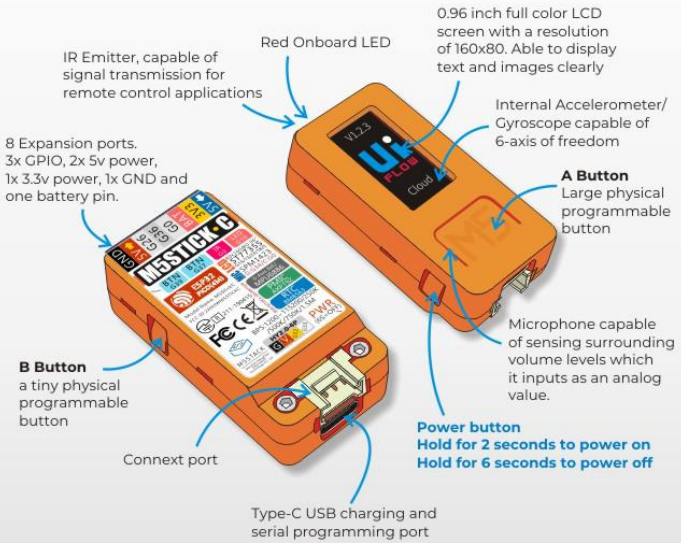
Preface

1、What is M5StickC?

M5StickC is a pint-sized programmable micro controller. It uses the versatile ESP32 Chip Which offers WiFi and Bluetooth connectivity, a 6-Axis accelerometer, Onboard LED and an IR Transmitter.
On the body of the device, we find 2 function buttons, an on/off button, and a grove compatible port for sensor extension. No matter whether your looking to create a simple remote control device or a more sophisticated IoT project. This Miniature device has got you covered. Even first time programmers will find it a great tool for learning to program.

Hardware Overview



Chipset Capabilities

CPU
All modern computers require a CPU (Central Processing Unit) to take care of all the calculations necessary to process information and make the computer run smoothly. We can think of it as the brain of the computer.

There are two kinds of memory in your computer
Ram: Ram is a volatile form of memory, meaning it will be cleared when the computer is turned off. It can be read from and written too very fast and so is used for storing data related to the tasks being processed at the time.
2.Flash (ROM) Flash is used as permanent storage on a computer, and it's contents will remain unchanged even if the computer is turned off.

Inputs
These are what your computer uses to receive interaction from the physical world. Mouse, keyboard, touch screen and microphone are some examples.

Outputs
These are what the computer uses to output data to the physical world, such as a speaker, screen or printer.

2、Similarities between M5StickC and a PC

CPU	✓	✓
Memory	✓	✓
Inputs	Keyboard, Mouse	Buttons, Accelerometer, Mic
Outputs	Screen, Speaker	LED, Lcd screen, IR Emitter

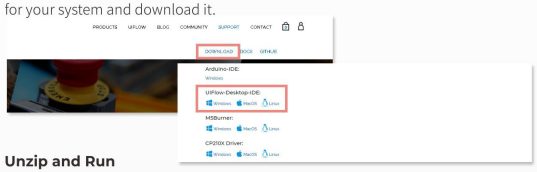
UIFlow IDE

UIFlow is a programming platform specifically designed for M5Stack hardware. It supports blockly, a block based visual programming system and micro python programming languages. It enables beginner programmers to pick up core programming concepts and make professional programs easily. In this chapter we will cover how to setup your device in UIFlow and create a simple program to flash an LED.

★ **Note: M5StickC loads with factory test program by default. If you wish to program with UIFlow IDE, please burn UIFlow firmware first. For details, please refer to the "Update Firmware" chapter in the appendix.**

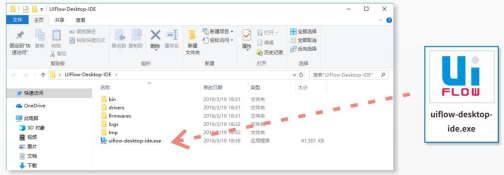
01 Download

Enter https://m5stack.com into your browser and select Software>Download from the top bar. Select the correct version of UIFlow-Desktop-IDE for your system and download it.



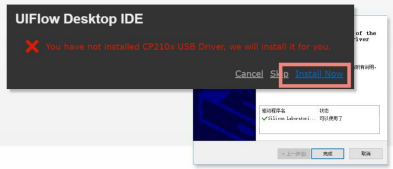
02 Unzip and Run

Once you have downloaded and unzipped the file, double click the uiflow-desktop-ide icon to run it.



03 Installing Drivers

The software will do a quick check to see if the driver has already been installed on your computer. Click “Install Now” and follow the install wizard if that is not the case.

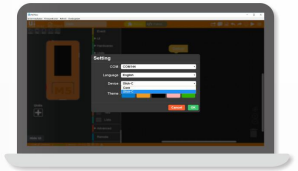


Notice

M5StickC Supports driverless plug and play operation on Windows 10/Linux/MAC(High Sierra+)Other systems may need FTDI drivers and CP210X driver install

04 Connect Device

After UIFlow Software installation is complete please attach your M5StickC to the computer using the USB-C cable supplied.



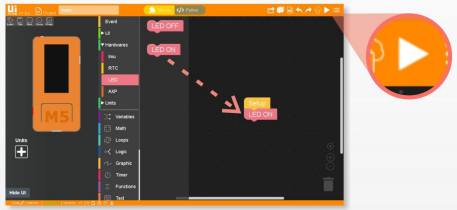
Type-C Cable

05 USB Programming mode

Long press the button on the left hand side of the device for 2 seconds to power on. After the UIFlow logo appears swiftly press the large M5 button to enter the settings menu. To cycle through the menu you can press the right hand side button. Cycle through until you see setup then press the M5 Button. On this Menu we can setup programming mode and wifi setup, for now select USB mode. In the software we can select the COM port. On MAC and Linux the device is likely to have a name like tty followed by a sequence of numbers and letters.

06 Run your first program

Select “Hardwares” from the blocks list, then select LED> LED ON and drag it into the coding area and connect it up to the setup bar. Finally hit the play button to send the code to the M5StickC. The red LED of the M5StickC should light up.



07 Updates

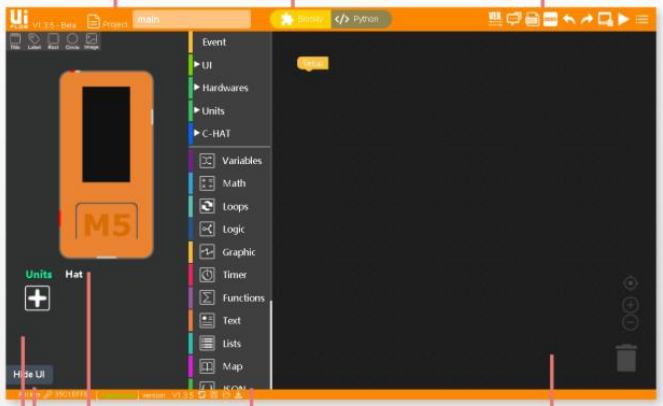
M5StickC has a firmware designed to work with UIFlow pre-installed. This firmware is frequently updated to add new features and fix bugs. It is important to keep the UIFlow software and firmware up to date.

UIFlow Introduction

Project Title
Enter your project name here. Whenever you download a program to your computer or M5StickC it will retain this name.

Blockly</>Python
This button allows you to see the Python code that your blocks have generated and edit that code.

Menu Tab
From this bar you can access the forum, documentation, examples undo and redo actions upload files to the M5GO, run your code on the device and alter the settings.



UI Preview
Drag text and visual elements on to the M5StickC screen to create a UI. Blocks will appear in the UI panel to allow you to manipulate these elements.

Code blocks menu
Here we can find all the blocks we need to create programs.

Coding Area
The coding area is where we drag blocks to, in order to build our program.

Units
Here we can pick which Units (Sensors/Actuators) we want to use in our project and which port we plan to connect them to.

Hide UI
Hide the Ui Manager panel to free up more space in the coding area.

Code Blocks Menu

The code block menu contains all the blocks you need to create a vast amount of programs. From Hardware blocks which directly interface with the hardware of the M5StickC to maths for calculations and Logic to tie it all together. Work slowly through the basic blocks first before you move on to anything too advanced.

Event
Here you can find Loop and button press event blocks.

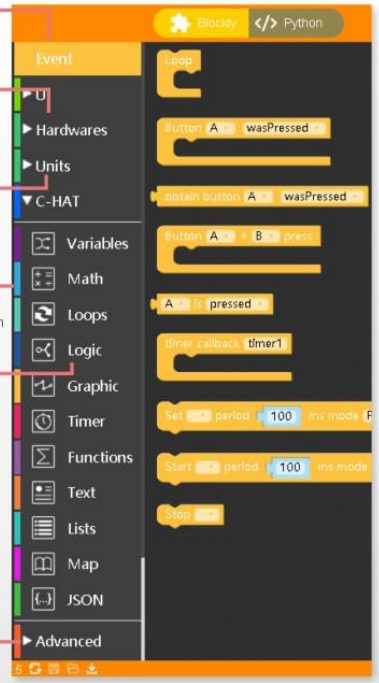
Hardwares
Program the internal peripherals of the M5StickC such as the LED, IMU, and Power management.

Units
Whenever you add a unit, it will appear hear along with all the code blocks related to it.

Math
Maths is essential in programming. Here you will find all the blocks necessary to make both simple and complex calculations.

Logic
Every program needs logic to decide which action to take when an event occurs.

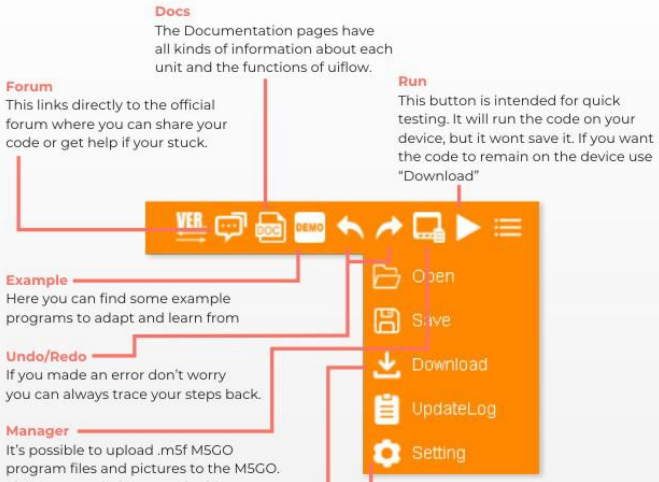
Advanced
Advanced blocks for experienced coders. You' ll find blocks for networking, digital/ analog pin control and more here.



Operations Menu

A closer look at the menu tab

This Main navigation bar gives you access to the forum, documentation pages, example programs undo and redo actions, file uploader, code on the device and alter the settings.



Coding Blocks Explained

Setup

The setup block is essential for any program to run. It defines the first thing that will happen when the code is uploaded or the device is switched on. It will only run once.

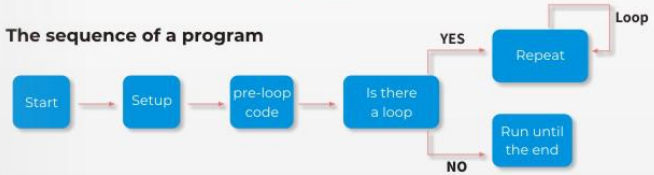
Loop

The loop block will run any code placed inside it indefinitely . That means unless you turn off the device it will continue to run without stopping.

Wait

The wait block will delay your program for however many seconds you input. Sometimes this is necessary to see the result of some code that might have otherwise run so fast that you blinked and missed it.

The sequence of a program



Code block connection

UIFlow uses blockly, a block based programming language. Blockly works a little bit like a jigsaw puzzle. When blocks are moved close together they snap into place and change color. This means they are connected and you have successfully created a chunk of code. If they don't change colour that means they are not connected and will not be run as part of the program.

UIFlow Tips

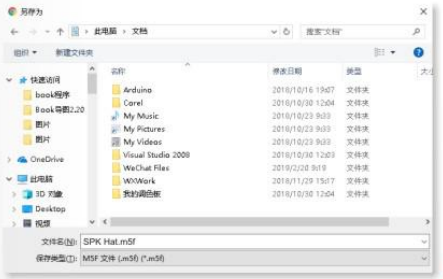
To duplicate a block, double click it with the left mouse button or right click and choose duplicate from the list.
To delete a block you can drag it back to the coding blocks menu or to the trash bin in the lower right corner.

Saving and uploading programs

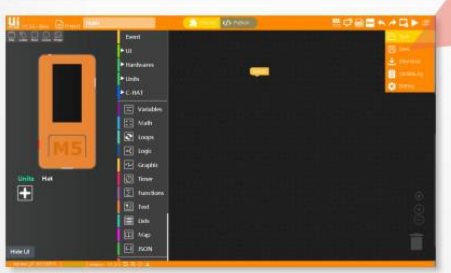
As we move through the lessons in this course we will go on to create more complicated programs which can not be finished in a short time.Therefore we can save our programs to our computer and upload them at a later date to continue working on them. It's always a good habit to save your work in case of a crash. To do this we can click save from the drop down menu and choose where we want to save it to. When we want to upload again, simply press open and find the .m5f file that we previously downloaded. Your program will be restored from where you left off.

01 Open the Uiflow website. (flow.m5stack.com)

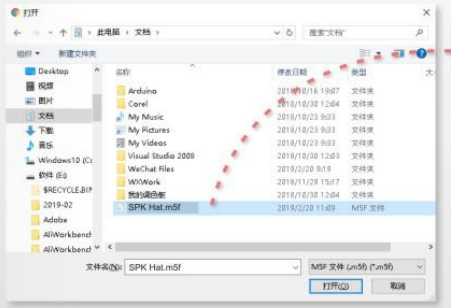
02 After you've finished coding click "Save"



03 Your program will be saved as a .m5f file



04 When you want to open a .m5f file, simply click "Open"



05 Find the file you previously downloaded and click open

CURRICULUM:

DIGITAL MUSIC

FLASHY GRAPHICS

TRAFFIC LIGHT

DIGITAL NAMECARD

DODGING GAME

「CURRICULUM」

IDEAS FAST TRACKED

1 HELLO WORLD

Introduction: While using UIflow you may have noticed the UI Manager on the left. This is for displaying text and graphics.
Lesson outcome: By the end of this lesson you should be familiar with the basics of creating a program and running it on the M5StickC. We will display some simple text that says "Hello World"

1-1 A programmers very first program

Hello world has long been held as the induction to programming, regardless of what language is being taught. It teaches the most basic of programming concepts and prints "Hello World" to the screen of the device. While it may sound simple, even some seasoned programmers may use this code as a test when trying a new language or device for the first time. Once we have learned the hello world program it will give you confidence to go on to learn more advanced things

1、Adding a label

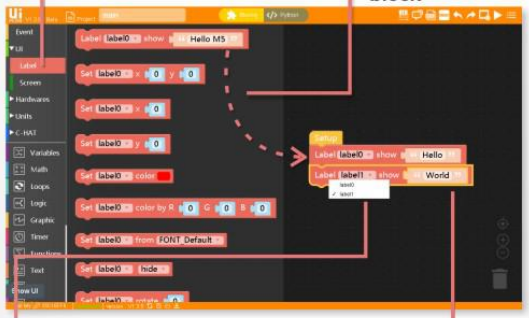
In the UI Manager we have a tool that enables us to quickly display text. It's very simple to use. All you need to do is drag down from the label icon to the screen.

01 Start by dragging a label on to the UI Manager from the top panel

After adding a label, click on the UI section of the blocks menu and you'll notice now there is a sub menu entitled "label" Inside label we'll find a bunch of different blocks which can be used to program the text label.

02 Click on the label blocks - select label show block

03 Drag it into the coding area and connect it to the setup block



04 Sometimes we may have many labels. In order to program the right block we need to choose this name from the drop down list of the label show block

05 Change the text to "Hello world"

Now you've created your very first program. That was easy wasn't it. Now in order for it to run on the M5StickC we need to make sure that your USB cable is connected and that you have entered into USB mode as instructed in the previous chapter.

07 Click on the play button at the top right hand corner of the window to run your program

06 If your M5StickC is connected properly you should notice The word "connected" in green. If you don't see it click on the refresh Icon next to it to try to reconnect

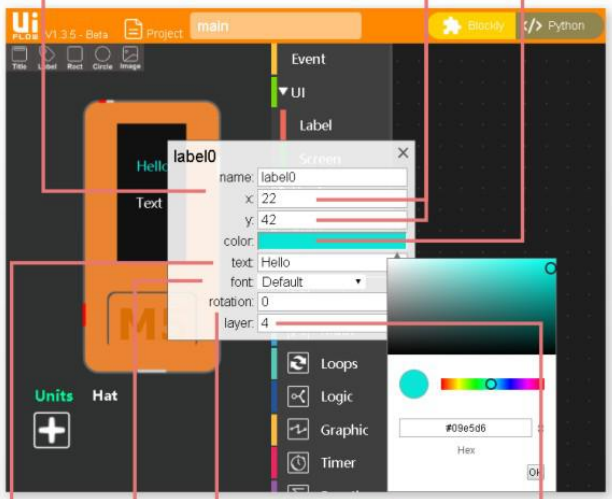
2、UI Elements Properties

Once we have added UI Elements in the UI manager we can click on them to bring up the properties menu. In this menu we can change the size, location, orientation, color and so on.

name
Here we can change the name of the label (not the content).

x/y
We can change the x and y coordinates (position) of the elements on the screen. The screen size is 80x160 pixels.

color
We can change the color by clicking here, adjusting the color bar, then selecting a color from the palette.



text
Here is where we alter the message that first appears on our text label.

font
In the font menu we can alter the font (style of the letters)we have a few fonts to choose from.

rotation
We can rotate the label by a certain amount of degrees.

layer
Layers allow us to shift text and graphics in front or behind each other.

3、Add/Delete Elements

Above the UI Manager are various UI Elements which can be dragged down to create your UI.

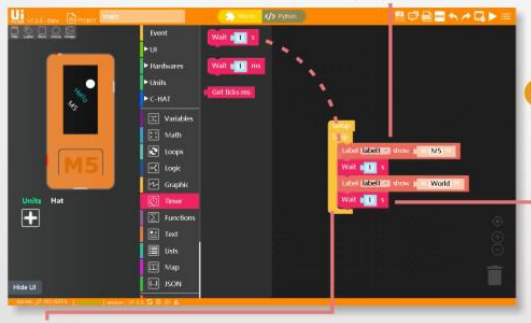
Whenever UI elements are added to the UI Manager, equivalent blocks will appear in the UI tab of the code blocks menu.

If we add elements by accident or decide we don't need them, they can be removed by dragging them to the trash bin above the UI Manager.

4、Programming UI Elements

By using the code blocks generated when UI elements are added we can program various characteristics of those UI elements.

01 Add 2 “Label Show” blocks and edit them to display a different message



02 We must add 2 wait blocks in between the label blocks to slow down the label change so that it is visible.

03 In order to repeat the code over and over we must place it inside the “loop” block found in events.

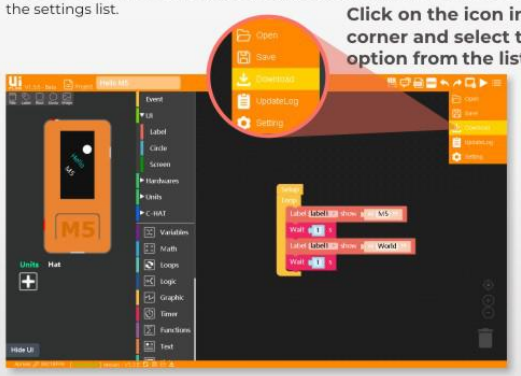
5、Project Title

Enter your project name here. Whenever you download a program to your computer or M5GO it will retain this name.

6、Running and Downloading Programs

During the course of creating programs we will want to test them from time to time. We can run our programs on the device by clicking the play button (White triangle). With this mode however the program will be erased once we reset the device. If we want to store the code on our device so we can show our friends we must choose the download option from the settings list.

Click on the icon in the top right corner and select the “download” option from the list.



Once we have selected “Download” there will be a message on the screen displaying “Uploading”, it will change to “Reseting” once the code has uploaded, and will also reset and run the code.

7、App List

All of the programs we have downloaded to the device can be selected from a list. We can access this list by pressing the M5 Button on startup. Doing so will give us access to a menu which we can scroll through with the button on the right side of the device. Cycle through until you see “APP List” and press the M5 Button again. Now you can select your programs from the list by scrolling with the right button and selecting with the M5 Button.

Notice: pressing the right button for 3 seconds will delete the highlighted program. If you download a program that has an identical name to one that is already on the device, it will overwrite it. The M5StickC will always run the program that you last uploaded to it or selected on startup.

2 DIY Watch

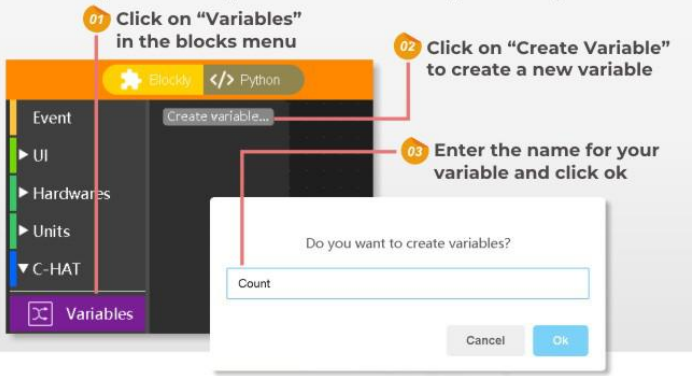
Introduction: In this chapter we will learn about variables, logic and button events and use them to create a watch program.
Lesson outcome: Understand variables, how we can create and use them and how nested conditions work.

1-1 Understanding Variables

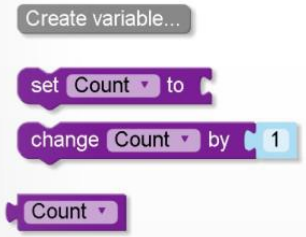
(1) We can describe variables in a simple way by using the example of a jar. First we give the variable a name e.g "A" and then we can either store a number or a bunch of letters in that variable.

(2) When we assign a new value to the variable the original content will be overwritten.

(3) We can also take the content of one variable and assign it to another variable, which would just be like taking the contents of the first bottle, making a copy of it and then placing it in the second bottle.



After creating a variable a block representing it will appear in the variables section.



1、Counter Program

Here we'll create a variable called count, assign 0 to it and connect it to the setup block. Then we'll display that variables contents on the screen with a label block, and add 1 to it for every second passed.

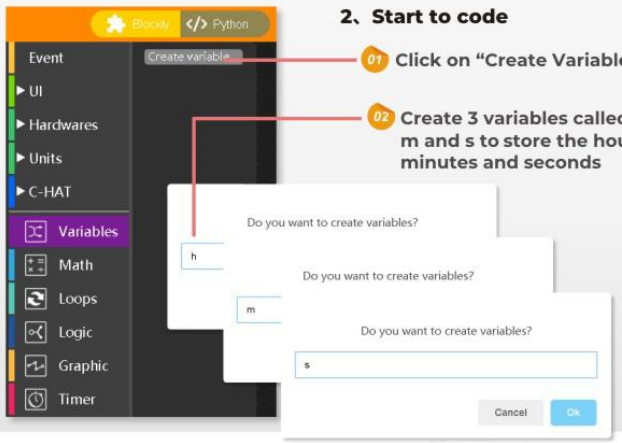
Now we have a counter that goes up every second. In order to create the watch, we need to remember that 60 seconds = 1 minute, 60 minutes = 1 hour and 24 hours = a day.

1-2 DIY Watch

1、Creating the display

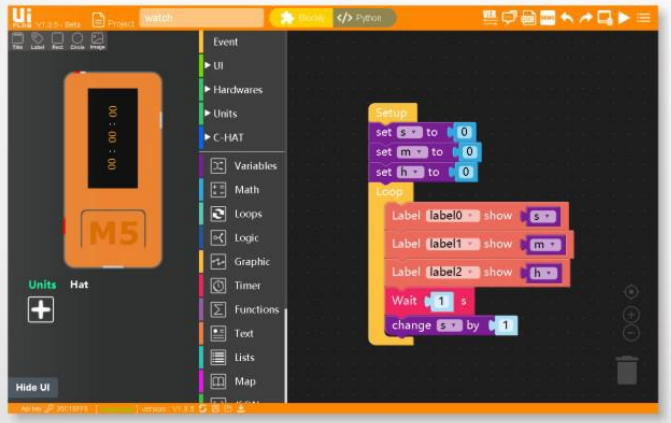
First we need to add 3 labels for the seconds, minutes and hours. We can first add 0's to the labels as a place holder and then adjust the font and color until we are happy with the result. Change the label names to h, m and s for hour minute and second.
This will make sure we don't get confused. Now add 2 more labels between the numbers and enter colons these will separate the numbers.

2、Start to code



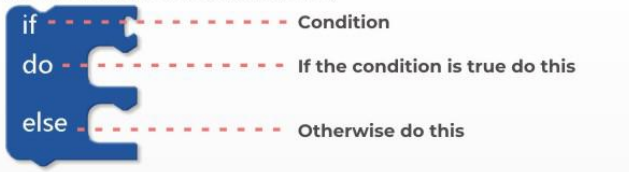
Drag a loop in and a set variable block and connect it to setup, choose s from the drop down list and enter 0 as the value. We can repeat this process for the minutes and hours.

(1) Put all of the set value blocks in the loop block and add another loop block below them.
(2) Add 3 Label show blocks and set each of the h, m and s variables to the corresponding label.
(3) Add a change s by block set it's value to 1 and add a wait for 1 s block below it.
(4) Since the loop already has an unseen delay value it won't be entirely accurate.



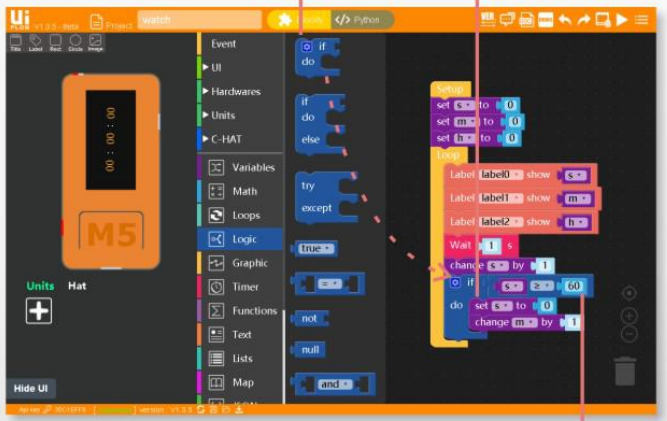
We use the label to display the content of the second, minute and hour variables. How can we make sure that the seconds are updated every second automatically, and that the minute position changes once the second variable has reached 60? For this we need to use a new block called the "if" block.

The "if" block allows us to steer the program in different directions depending on what input we receive. Then whenever the condition is met, the code in the do position is executed. Otherwise the code in the else position is executed.

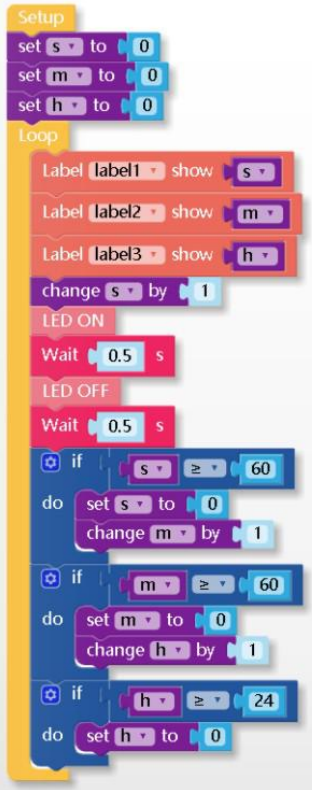


We only need to update each position to reflect the current time, which only requires simple logic. Therefore an "if/do" block will be sufficient

Once the seconds variable has reached 60 we set seconds back to 0 and add 1 to the total of minutes



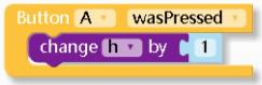
We check if the variable "s" is more than 60 with the comparator block

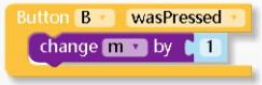


3、If Conditions

We will check in each position to see whether the counter has reached 60 or 24 in the case of hours and use that as a condition to trigger the next event, whether it be resetting a position back to 0 or adding one unit.

We can also add two button pressed blocks in order to set or adjust the time.





Add 2 "button pressed" blocks from the events section and add "change by" blocks to change the minute and hour variables.

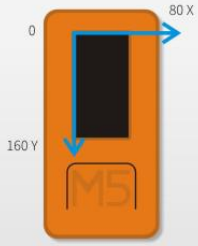
3 Flashy Graphics

Introduction: Display graphics on the screen and understand the coordinates system.
Lesson Outcome: Become familiar with the X/Y coordinates system. Explore the Random blocks and use them to generate graphical elements at randomized positions on the screen.

3-1 Understanding Coordinates

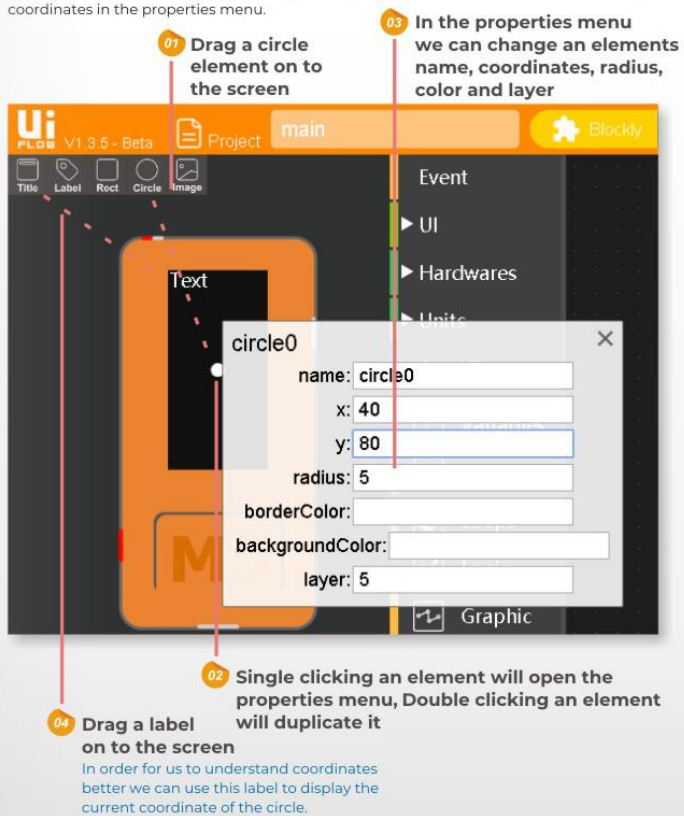
Coordinates are incredibly useful in allowing us to place an element at an exact position on the screen. We can also use them to calculate a distance between two points on the screen. We come across coordinates often in day to day life. Think of a map, Coordinates allow us to know exactly where we are on a map and where to head to next. Just as a map has a grid of squares our screens also are made up of a grid of many small squares called pixels.

The M5StickC screen has a resolution of 80x160 pixels the X axis or horizontal axis has a width of 80 pixels and the Y or vertical axis has a width of 160 pixels. Whenever we draw a pixel on the screen or some other graphical element it will have a specific x/y coordinate within that range. If we use a value outside of that range it will not appear on the screen.



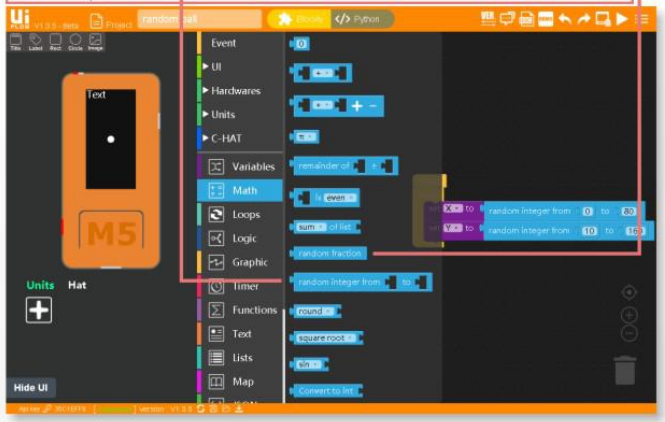
3-2 Display a circle

In this chapter we will use the UI manager to display a circle on the screen and set it's x/y coordinates in the properties menu.



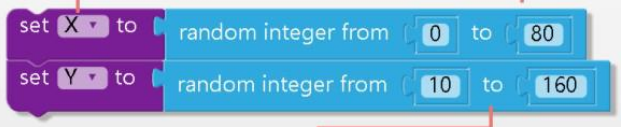
Random numbers

In the maths section we can find two blocks that allow us to generate random numbers.
"random fraction" Randomly generate a fraction with a decimal point e.g 0.2
"random integer from a to b" randomly generate a whole number within the range of numbers specified.



01 Create an X and Y variable to store the coordinates

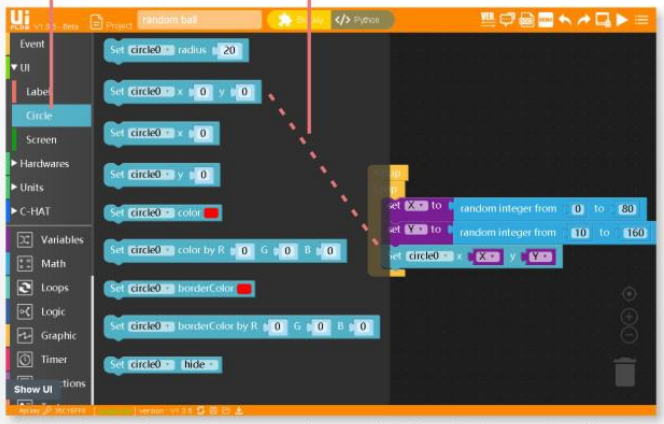
02 Assign a "random integer" block to X and set its range from 0-80



03 Assign a "random integer" block to Y and set its range from 10-160

04 Click UI, and drag a "circle x/y" block out

05 Add the x and y variable blocks to the circle



After creating the above code we can run it to see the ball randomly appearing all over the screen. Next we want to get the label to display the current x/y position of the ball. We only added one label though, so how can we display both values in one label at the same time?

Here we use two new blocks found in the "Text" section:

Convert to string block
Convert a number to a string, if numbers becomes strings their value will not be added.

Connect strings
Create a longer string by combining multiple strings.

Place one "connect string" block inside another then place a "convert to string" in front of an x and y variable. Place these in the first and last positions of the string connector block we have created and then attach it to a label show block.

For us to be able to see the change in coordinates clearly we will need to add a "wait for 1s block"

4 Accelerometer Application

Introduction: In this chapter we will use the accelerometer to change the screen color.
Lesson outcome: Understand how the accelerometer works, learn a little more about logic and control flow.

What is an accelerometer?

An accelerometer measures an increase in acceleration of an object along a fixed line with in a given time. Usually the time in which the measurements are taken is a short duration, in the scale of milli and microseconds.

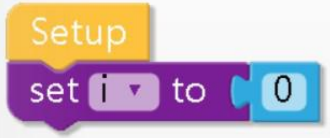
For example a car accelerating along a straight road may go from 20 mph to 30 mph in the space of a second. Therefore we would say that there had been an increase of 10mph within that second.

Quick question: 2 cars are sat motionless on a road, then they both accelerate to 40. One car only takes 6 seconds to reach that speed, while the other takes 10 seconds. Was their acceleration the same?

Of course not, the car that took the least amount of time to reach 40mph clearly has a greater acceleration than the car that took longer to reach the target.

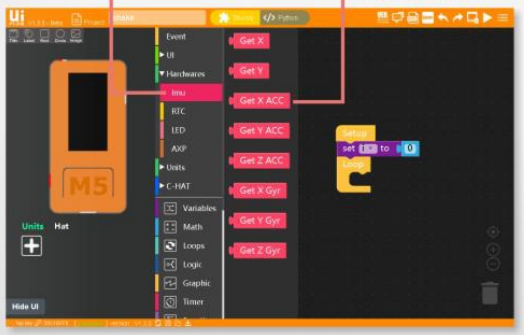
Acceleration is present in all aspects of our lives, even down to a small movement of our hand from one position to another. It's acceleration changed during the course of that movement.

Next we we will use the input of the accelerometer to control the colors on the screen.
(1)Create a variable called "i" to choose which color is displayed.
(2)In setup assign "0" to the variable "i"



01 Click "Hardwares" and select "IMU"

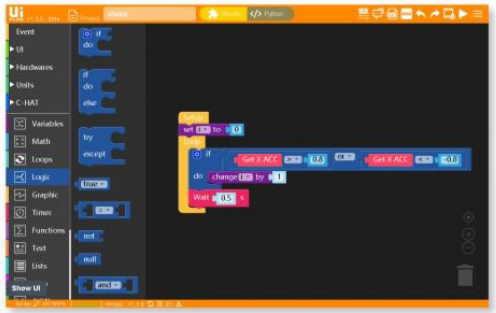
02 We will use the "Get X ACC" block to check the acceleration on the X axis



4-2 Control flow

By checking the state of the accelerometer we can sense if the M5StickC has been shaken, and if so change the variable which will in turn change the colors of the screen.

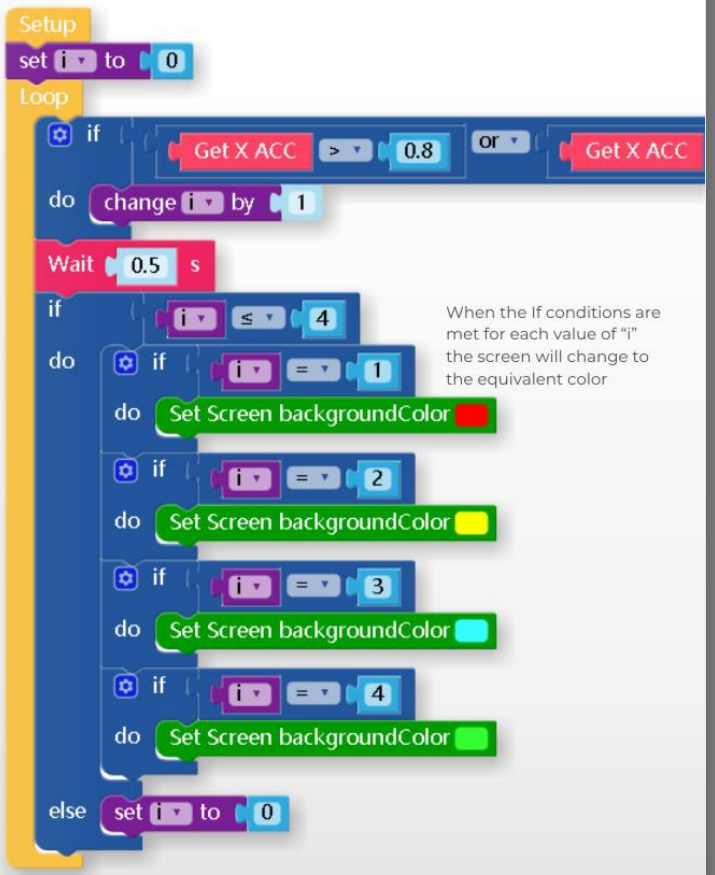
Create a variable to store the amount of shakes. Then we assign 0 to this variable and change it by 1 for every shake.



Set the threshold for the X Acc to be 0.8.

The logic comparator block has three options: and, or and not
(1)and - Both conditions on the left and right must be satisfied, if one is not it becomes false.
(2)or - True is returned if one or the other condition is met, if neither then it is false.
(3)not - if the condition specified is not met then it equates to true otherwise if met it equates to false.

We change the color of the screen depending on the number of shakes. If the number goes over 4 we reset it back to 0.



When the If conditions are met for each value of "i" the screen will change to the equivalent color

5 Digital Name Card

Introduction: In this chapter we will make a digital name card, when a button is pressed it will display the persons details.
Lesson outcome: Learn how to create lists and populate them.

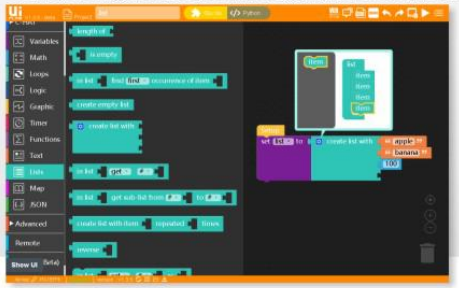
1、Understanding Lists

What is a list? We could say that a list essentially gathers together a bunch of variables in one easy to manage set. We previously described the variable as being like a bottle, we can then liken the list to a storage container for those bottles. Each bottle has its own numbered position in storage and this number can be used to get the data from that variable or change it.

When creating a list we must assign the list to a variable, then whenever we want to get data from the list we just use that variables name and state the position within the list from where we want to obtain the data.

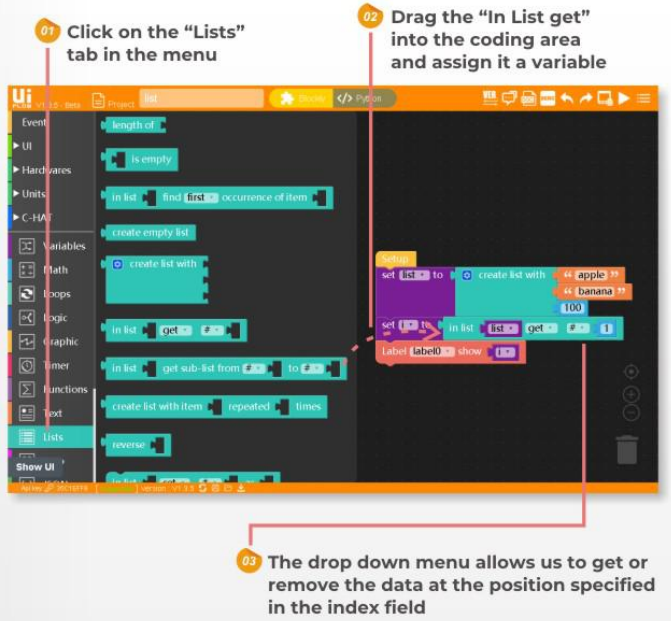
2、Creating a List

First we'll create a variable which we can call list, then we drag the "set list to" block to setup. In the blocks menu we can find a section called "lists", here we find the "create list with" block and drag it to the "set list to" block. Now to fill the list with data we can drag number blocks from the maths section, string(text) blocks from the text section or even other variables into the empty slots on the "create list with" block. Each block that we added to the list is now assigned a number starting from 1 in the first position, we can add more positions to the list block by clicking the little gear and dragging more item blocks in.



3、Using Lists

Once we have created a list and populated it with some data, we need to learn how to use this data and how to alter it according to our requirements.



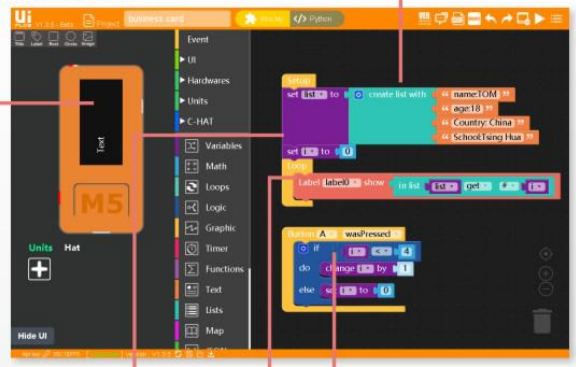
In UIFlow the index of lists starts from 1 however in Python it is 0. If we want to get the text M5 from the list we should use the index number "1".

Quick Question: Can we use a variable to cycle through the positions of the list?
Definitely, this is one of the most useful features of a list which has so many possibilities.

5-2 Make your own digital name card

01 Add a label to display the name card contents. Since the display width is not very wide we can rotate the text 270 degrees to take advantage of the vertical width

02 Create a list to store the information of the name card



03 Create a variable and set its value to 1 this will act as the position in our list

04 Add a label show block to display the contents of the list

05 Add an “A button pressed” block to control the position of the list index variable “i” Since our list only has 4 positions we use the If block to increase the index and set it back to 0 if it goes above 4

6 Dodging Game

Introduction: Display a square on the screen and use the accelerometer to control it.
Lesson Outcome: Discover iterative loops, how to use them and how they are useful for making games.

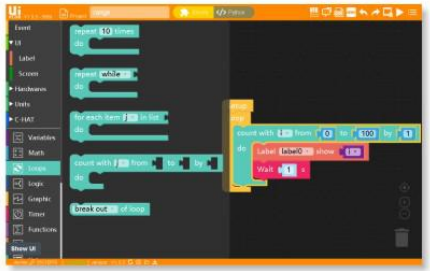
2-1 Understanding Iterators

We can understand iterative loops as a piece of code that repeats a set of commands by using a variable as an index within a range. Once the index variable has reached the end of the range it will exit. We could liken it to the register in your class at school. The variable is the current students name in a list once all of the students names have been called the call of the register will be over.

Quick Question: Why do we need to use an iterator and what benefit does it bring to the program
We can demonstrate with a simple example.

Lets have a comparison of two ways to iterate numbers and see which one is more efficient. The goal is to count up from 0 - 100 in increments of 1.

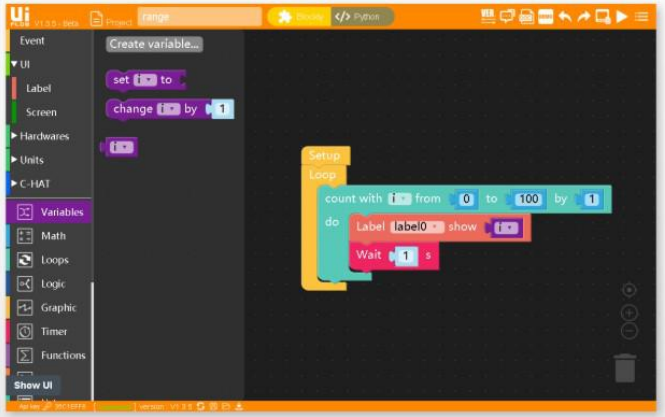
Method 1
While “I” is less than 100
change “I” by 1
once “I” is more than 100
reset the value back to 0.
Add a 0.1 - 1 second delay
in order to see the change
in the numbers.
Place all of this code inside
a loop.



Method 2
Using the "count with i from" block we can set "i" to 0 , its max range to 100 and its increment value to 1. We will add a 1 second delay inside the count loop, so the program will run for 100 seconds. If we use a label show block and insert the "i" variable into it we will see the numbers increment by 1 up to 100 and then reset back to 0.

We can see that the second method using the count block has simplified our program. It has many more uses than just simplifying code though as we will go on to see.

Supplementary information
In UI flow whenever we add a count block the variable "i" will be automatically generated, but we can also create other variables and assign them to the count block from the drop down list.



6-2 Setting coordinates with the count block

01 **Add a rect element to the screen**

02 **Using the count block we can gradually alter the coordinates of the rect element**

03 **The rect elements origin is in the top left hand corner. in order for the rect to emerge from the top of the screen and reset its position once it has disappeared from the bottom of the screen. We need to set the range in the count block from -20 to 160**

04 **Altering the delay time in the wait block allows us control the speed of the rect element**

05 **Using the random block at the start of the loop we can set a random X position for the rect element before it starts to fall**

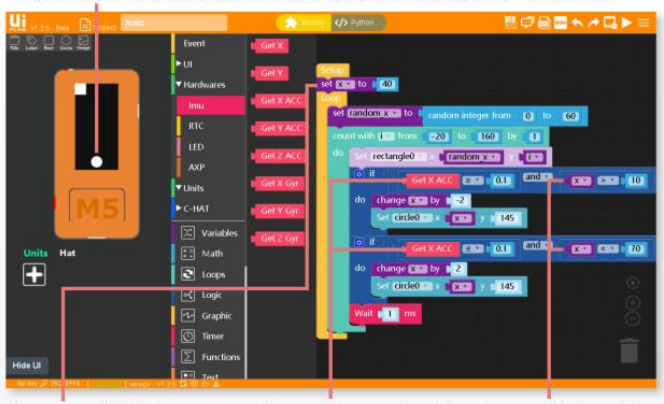
06 **We set the random integer blocks range from 0 - 60 to prevent the rect element from disappearing off the right hand side of the screen**

07 **The random integer will now dictate where the rect element will appear at the start of each loop**

6-3 Ball Control

Now we need to create a ball to be our player and use the accelerometer to control its movement to the left and right.

Add a circle element and make sure it sits at the bottom of the screen



Create a variable X to store the circles position on the X axis. Set its initial value to 40 so it will be at the centre

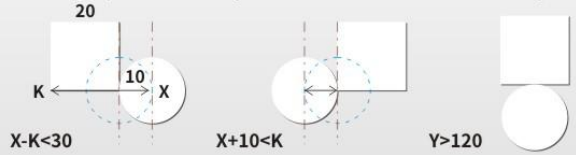
We use the reading of the accelerometer to reduce or increase the x position of the circle in order to make it move

We use the less than more than comparators to prevent the circle from disappearing off the edge of the screen.

6-4 Collision Detection

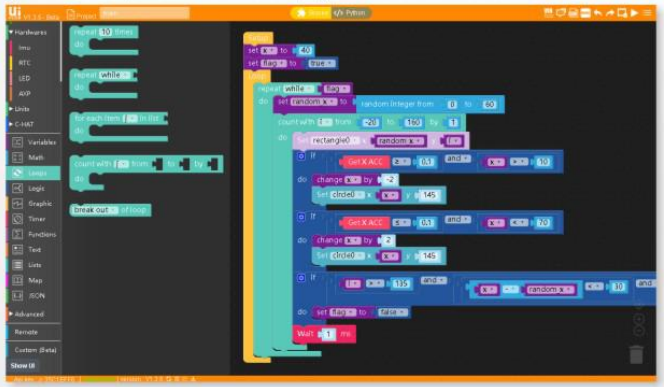
When designing this game we need to create the mechanic for how to lose or gain points.

Here we can look at 3 different scenarios, did the squares right side and the circles left side touch, did the squares left side and the circles right side touch or did the bottom of the square touch the top of the circle. Only if one of these conditions is met will the game be over.



Running The Game

We will discover that after running the program the game will begin automatically, we did not program a way to manually start the game. During the game, after the ball has collided it means game over, but we have to design a way to make the game end and be able to restart. and stop the ball from falling. We should use a game state to check whether the game has ended, or is still in the state of play. Let's have a look how to do this below.

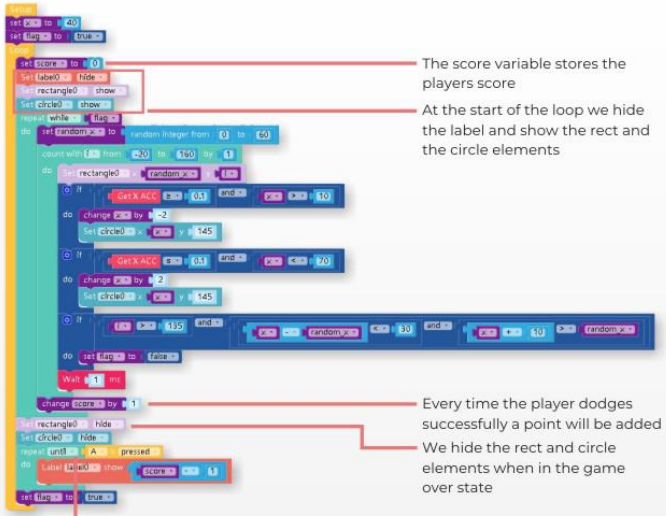


The repeat until block will repeat whatever code is put inside it until the specified condition becomes true, if the conditions met the loop will end.

The repeat while block will repeat whatever code is put inside it whilst the specified condition is true, if the condition changes to false the loop will end.

6-7 Program Optimization

Now we've created the basic structure of the game including the game over scenario. Next we need add a scoring system and a way to reset the game.



The score variable stores the players score

At the start of the loop we hide the label and show the rect and the circle elements

Every time the player dodges successfully a point will be added

We hide the rect and circle elements when in the game over state

Until the A button is pressed the score of the last game will be displayed. When the game is over the variable "i" hasn't reached 160 so it wont automatically exit the loop. All of the code within the while loop will be executed once before exiting. Therefore the score will not be accurate, we need to rectify this by reducing the score by 1. After pressing the A button the boolean flag will be reset to "True".

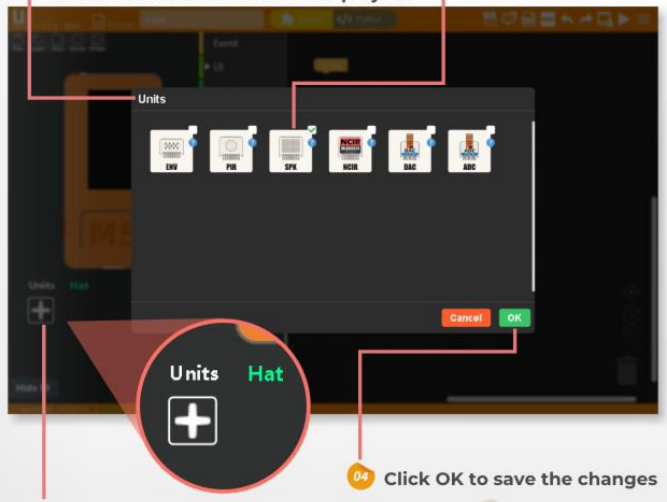
7 Digital Music

Introduction: We will use the speaker HAT to produce sound from the M5StickC and create a simple melody.
Lesson Outcome: Understand some of the science behind sound and learn how to use the repeat blocks.

Adding HATs

02 The HAT menu allows us to add various HATs or sensors to our projects

03 Select the SPK HAT



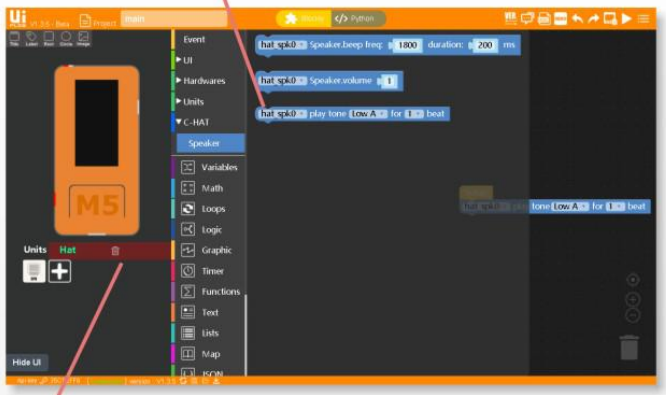
04 Click OK to save the changes

01 Click on HAT and then the plus button to enter the HAT Menu

SPK

HAT Usage

When we add a new HAT to our project we can see the related blocks in the C-HAT section of the code blocks menu, Each HAT has its own unique set of blocks which vary according to its usage. The blocks will help us to get input or produce an output from the HAT. We need to make sure the HAT is firmly connected to the expansion port of the M5StickC before uploading the code to achieve the expected results.



Removing HATs

If we accidentally added a HAT we didn't need or don't want to use a HAT any more we can click on its picture and a trash bin will appear above the Ui Manager. We can drag the unwanted unit into the trash bin to get rid of it.

1-1 Making music

In this chapter we will look at how to produce sound from the M5StickC speaker hat and create a simple song but first let's ask a question. What exactly is sound?

Sound put simply is vibration. To demonstrate this place a ruler on the edge of a table and whilst holding one side down pull the other side down and release. Did you hear the sound and feel the vibration on your fingers?
Try moving more or less of the ruler over the edge of the table. The vibration of the ruler creates distinct sounds.

In the experiment we observed the ruler moving faster or slower and producing higher or lower pitch notes. The speed of the vibrations is called frequency and is measured in Hz(Hertz)The average human ear can hear sound in the frequency range of 20 Hz to 20 kHz. If we enter any amount higher or lower than that into the speaker block, we are unlikely to hear it.

Tone and frequency

Now that we are familiar with a bit of the science behind sound, lets get started in using the Speaker blocks to create music. In the blocks menu, select "Hardwares" then "Speaker" then drag and connect the block up to setup. Try to alter the frequency in the first box and the beep duration in the second. Run the program and see what results you get.

Since it would be difficult to remember all the frequencies that make up a song, we invented musical notes. The letters "C-D-E-F-G-A-B" represent those different frequencies or tones. These notes are repeated up and down the piano at a higher or lower pitch. Here is a chart showing the equivalent frequency in Hz for each note.

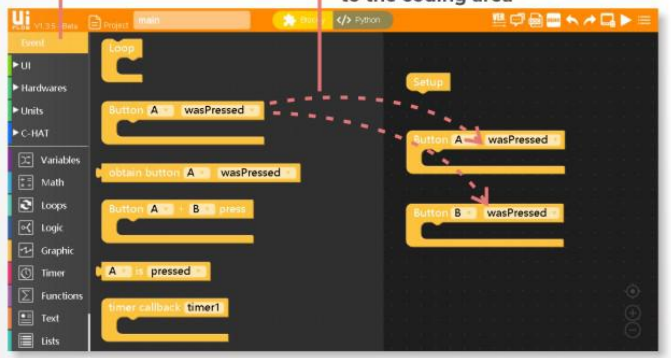
	C	D	E	F	G	A	B
Low	131	147	165	175	196	220	247
Middle	262	294	330	349	392	440	494
High	523	587	659	698	784	880	988

In the speaker blocks we can also find a block which allows us to create melodies from musical notes. The first drop down list allows us to select the note and the second allows us to adjust the beat or duration of the note.

Lets make a simple program to show the relation between frequency and tone

01 Click "Event"

02 Drag two button pressed blocks to the coding area

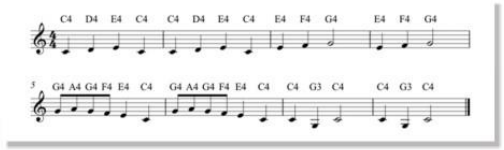


03 Click "Speaker"

04 Drag a "speaker beep freq" block into the first button press block and "Play tone" into the second

05 Run the program and press the A button followed by the B button. You will notice that they both produce the same sound

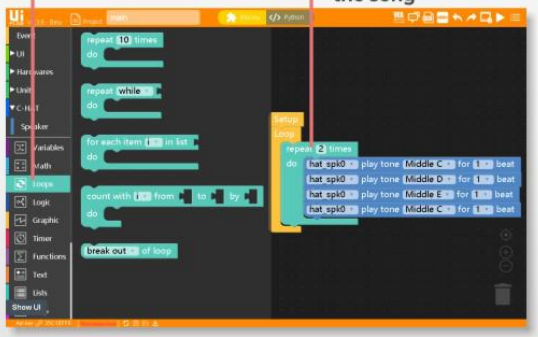
Let's use the play tone blocks to create a simple tune.



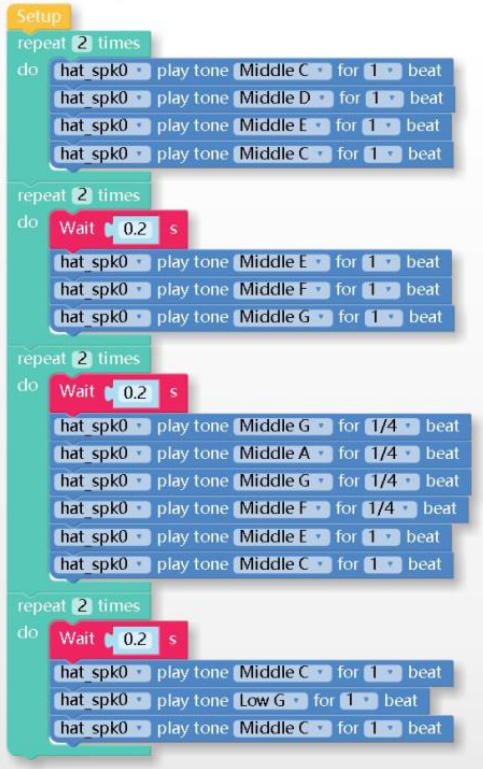
Above we can see a piece of sheet music with the notes we need to create the song. You may have noticed theres quite a bit of repetition. In programming we want to avoid unnecessarily repeating things. Our code is bound to get longer the more complicated it gets, but in this program we can reduce its length by using the repeat blocks. A repeat block is a sort of loop that only runs for a set number of times, often referred to as an iterator. So the number we set in this block is the amount of times our code will run.

01 Click "Loops"

02 Set the repeat times to 2 and add the tone blocks for the first part of the song



This is what the full song looks like with the repeat blocks. adding the repeat blocks makes our code neater, shorter and saves time.



It's a good practice in programming to avoid typing the same things more than once. Rather we should try our best to make use of the tools we have to reduce repetition.

1-2 M5 Orchestra

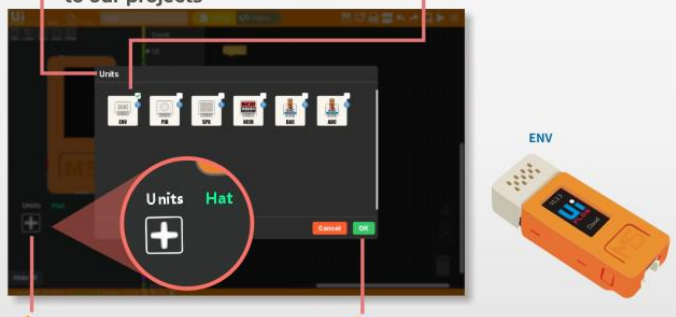
Try this in your classroom or with your friends. Each person should program their M5StickC to produce a different note on the press of a button. One person should be the conductor pointing to who should press their button. If you work together you could play a whole song this way.

8 Digital Thermometer

Introduction: In this chapter we will use ENV Hat to create a digital thermometer.
Lesson Outcome: Understand the function of the ENV Module, and use the UI elements to display its readings.

8-1 Introducing ENV

The ENV(Environment)-HAT is a detachable sensor which can sense temperature, moisture, air pressure and magnetic fields. It can be very useful to know the current temperature, for instance when growing certain plants. Using the ENV-HAT we can also predict weather conditions. This sensor has a temperature sensing range of -20 ~ 60° a moisture sensing range of 20 ~95%RH(Relative Humidity), and an air pressure sensing range of 300-1100PA (Pascals).



8-2 Read the sensor values

Using the UI Label elements we can easily display the current sensor values on the screen.

In the following section we will create a neat UI to display all of the information.

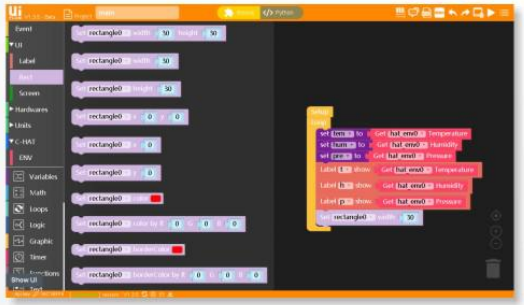
8-2 Data Visualization

In the UI Manager we can add 6 labels. 3 of them will display which sensors data will be displayed and the other 3 will display the values from those sensors.We will also add some rect elements to display the data visually.

Add 3 Rect elements with a thickness of 1 Alter the colors if you like.

Add the labels for the sensor type.

Add the labels for the sensor readings.



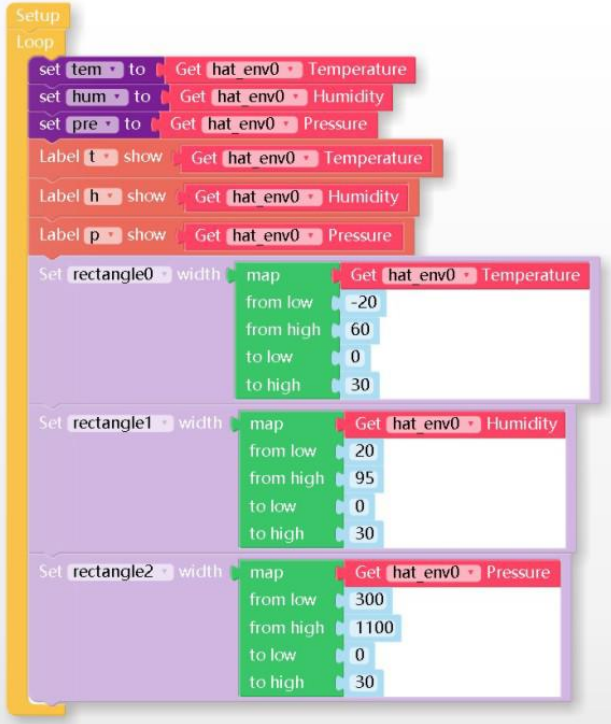
Our aim is to use the rects to display the temperature, moisture and air pressure but the screen has a limited resolution of 80x160 and the sensor readings are likely to exceed that number. Therefore we need to use the map block to adjust the input values to a lower range which will fit into the confines of the screen.

Now we use the map block to set the sensors low to high temperature range between -20 - 60 and then map that to a range of 0 - 30 which will control the thickness of the temperature bar so we can display the temperature level visually within the confines of the screen.

What is mapping?

We can use the map blocks to solve this problem. the map blocks take one set of values and transpose it to another. For example if we change one currency into another such as dollars to pounds, the exchange rate dictates that the value of the money is not the same as the original value. Currency values are always changing but we can input a set value and change It to whatever value we want.

We can use the same method as we used for the temperature level bar to create bars for moisture and air pressure using the values provided below. Once you've done make sure the ENV-HAT is connected and then run the code to see the result.



APPENDIX:

FIRMWARE UPGRADE

APPENDIX

「APPENDIX」

IDEAS FAST TRACKED

WIFI CONFIGURATION

LEARN MORE:

FIRMWARE UPGRADE

Firmware Upgrade

WIFI Configuration

Learn more

Appendix

Setup Wifi

Other than supporting programming over USB, the M5StickC can also be programmed wirelessly over the internet. The web version has some extra feature related to wireless communications and IoT.
Although the web IDE and offline IDE look almost the same, the main difference is we must connect our device to wifi before we can use it. We also need to use the devices API Key to pair it with the website.

Wifi Setup

01 **Press the power button on the left side of the device for 2 seconds to power on. Once the logo appears press the M5 button**

02 **Press the button on the right side to cycle through the menu until you see setup**

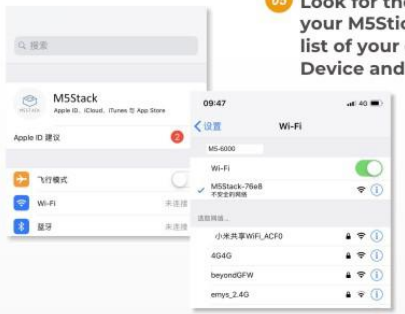
03 **Press the M5 button to select**

04 **Choose cloud mode from the menu**

Notice:
Depending on whether you want to use Wi-Fi mode or USB mode, you will need to go into this menu and switch to the preferred mode each time.

Entering the Wi-Fi settings menu will allow you to setup new networks or delete previously configured networks

05 **After selecting "change wifi connect" The screen will show the hotspot name of your device**



05 Look for the hotspot name of your M5StickC in the Wifi Settings list of your computer or Mobile Device and connect to it

06 Once connected open a browser and enter the IP address 192.168.4.1 to enter the network settings page

07 Select the Wifi network that you wish to connect to and enter your password. Click the connect button, and once your device is connected it will automatically reset.

Linking your API Key

01 When rebooting the device you will see the cloud mode screen. The spherical icon will change from red to green once connected to your network

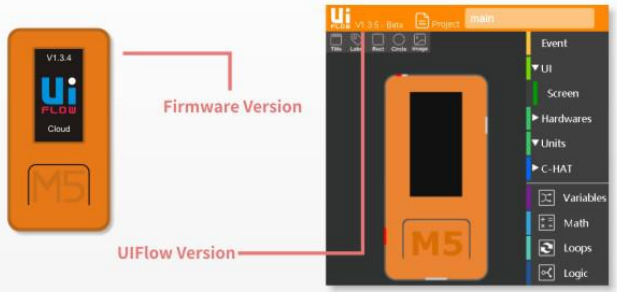
02 Enter the web address flow.m5stack.com to open the UIFlow web page. Once the page has loaded it should automatically bring up the API Key setting. If not, click the small gear in the upper right hand corner to enter your API key

03 Make sure to select M5StickC from the device list

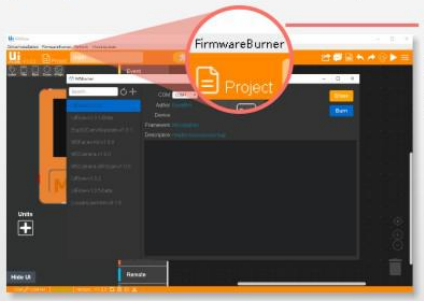
04 Double check you have entered your API Key correctly and click OK to save your settings, once connected we can start programming

Updating Firmware

In order to keep up with all the latest features of UIFlow we will need to update the firmware on our device from time to time. The M5StickC firmware version should be the same version as the UIFlow software.When booting up your M5StickC device you will see the firmware version in the top right hand corner. In UIFlow you can check the firmware version in the upper left hand corner. If you notice that the UIFlow version is greater than that on your device it means the UIFlow software has been updated and you need to update the firmware on your device accordingly. The UIFlow software comes paired with a firmware flashing tool, which allows us to update the M5StickC firmware.



Notice: Most modern systems should not require a driver for the M5StickC. For older systems you may need to install the VCP(virtual com port) drivers from ftdichip.com.



Click on the Firmware Burner tab in the upper left corner of the UIFlow Desktop software to enter the firmware burner

1、COM

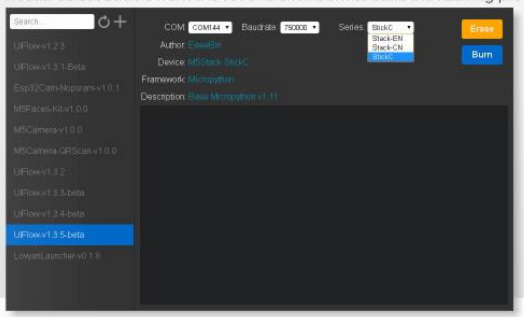
When your M5StickC device is connected to the computer it will be assigned a COM port number. We must select this from the drop down list in order to flash the firmware to the correct device. On widows it will be named COM with a number after it e.g. COM32. On Mac and other systems it may look like this: /dev/tty.usbserial-xxxxxxxxxx.

2、Baud

The baud rate is the speed at which the firmware is flashed to the device. Generally 115200 or 921600 are the best option.

3、Series

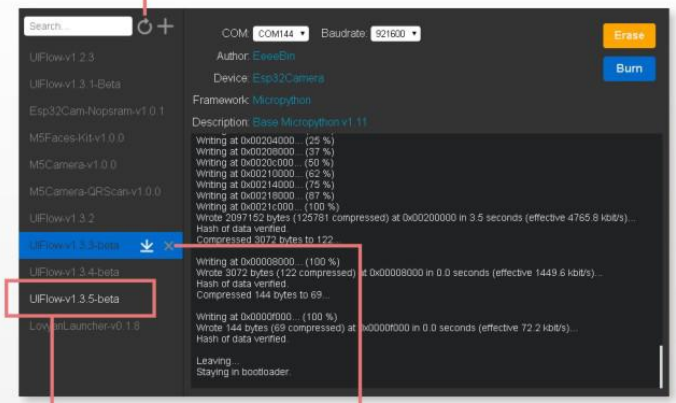
Choose your desired firmware, it may be the latest or an older version depending on your needs. Select Stick C from the list and click burn to start the flashing process.



4、Firmware Version

Choose the firmware you wish to download from the list on the left. There are legacy firmwares and alternative firmwares. Some firmwares are specific to a certain device. If you wish to program the M5 Stick C in UiFlow you must flash one of the UIFlow firmwares.

01 Click the refresh button to check for other new firmware versions (Requires Internet Connection)



02 The firmwares highlighted in white are those that have already been downloaded and can be flashed

03 Firmwares in gray can be downloaded by clicking the white download icon next to them.Select from more firmware versions

5、Flashing the firmware

Select the firmware you want to flash and make sure the series is set to StickC.

01 Before we flash a new firmware to our device it is best to “Erase” the storage of the M5GO device. When you see the message “finished” displayed the storage has been wiped. We can choose not to fully erase if we have already setup a wifi network on the device as these details can be preserved

02 Click “Burn” to begin flashing, again the message “Finished” will be displayed once the flashing process is complete

In conclusion

- Visit https://m5stack.com to find more information and resources about M5Stack.
- We hope that in reading this book you were able to pick up the basic concepts of programming the M5 Stick C in UIflow. We also hope that you had fun while learning to code and used your new programming skills to create your own programs. This is just the start of your programming journey and you still have much to learn.
- There are many M5 Stick C accessories that can be used to expand the functionality of the M5 Stick C Why don't you give them a try, they can be purchased from the links below.

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