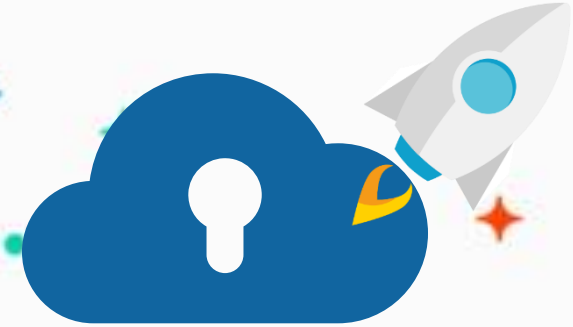

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Lesson 7. Digital Countdown

LECTURER:

Lesson Objective

Learning Objectives

1. Realize the countdown displaying two digits.
2. How to use the algorithm.

Possible Difficulties

1. Calculation method of single-digit and tens-digit.
2. The effect of absolute value and rounding down.



Background Information

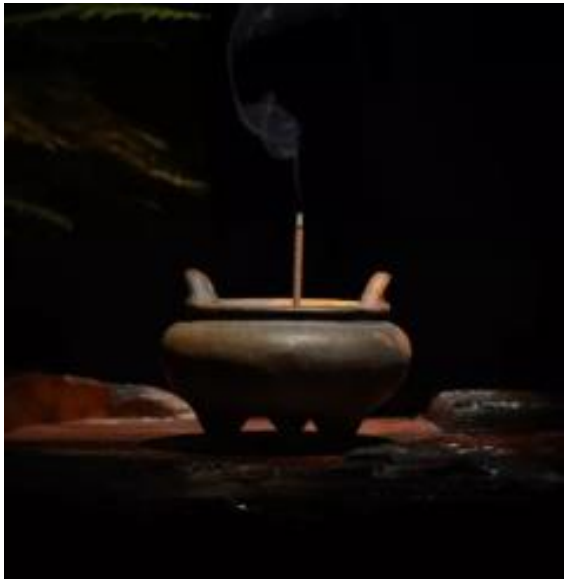


Background Information

Ancient Chinese Hours (时)	Modern Equivalent
子 - zi	11 PM - 12:59 AM
丑 - chou	01 AM - 2:59 AM
寅 - yan	03 AM - 4:59 AM
卯 - mao	05 AM - 6:59 AM
辰 - chen	07 AM - 8:59 AM
巳 - si	09 AM - 10:59 AM
午 - wu	11 AM - 12:59 PM
未 - wei	01 PM - 2:59 PM
申 - shen	03 PM - 4:59 PM
酉 - you	05 PM - 6:59 PM
戌 - xu	07 PM - 8:59 PM
亥 - hai	09 PM - 10:59 PM

In film and television works, we often hear Traditional Chinese timekeeping methods such as a stick of incense, a cup of tea, etc. Do you know how long they each represent? In ancient China, a day was divided into twelve units, each equal to two hours today. And further divisions were made on this basis to make the time more precise.

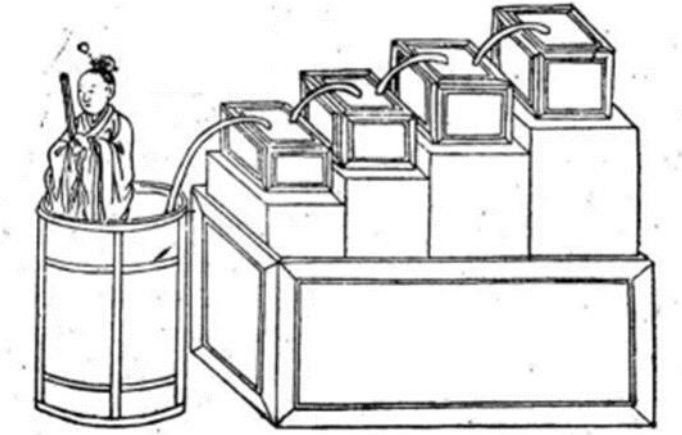
Background Information



There are twelve hours in a day, and one hour is two hours of modern time; one hour has eight quarters, and one quarter is 15 minutes of modern time; one quarter has three tea time, one tea time is five minutes of modern time; one tea time has two sticks of incense, the time of one stick of incense is 2 minutes and 30 seconds; the time of one stick of incense is 5 minutes, and the time of one minute is 30 seconds; Second.

These are all modern people's calculations of ancient timekeeping. In fact, the error began to increase after the "one quarter" of the ancient time unit.

Background Information



In order to improve timing accuracy, ancient scientists invented many different types of timing tools, among which the Water Clock is a typical representative, and the timing is carried out in the form of flowing water. Part of the data records that the accuracy of the Water Clock is 20 seconds per day, which was quite a remarkable timekeeping tool at that time.



Knowledge Introduction

Knowledge Introduction



The word “countdown” comes from the 1927 German fantasy feature film , *The Moon Maid*. In this film, director Frieze designed the launch program of "9, 8, 7, ... 3, 2, 1" ignition in the shot of the rocket launch in order to increase the artistic effect and be exciting.

Knowledge Introduction



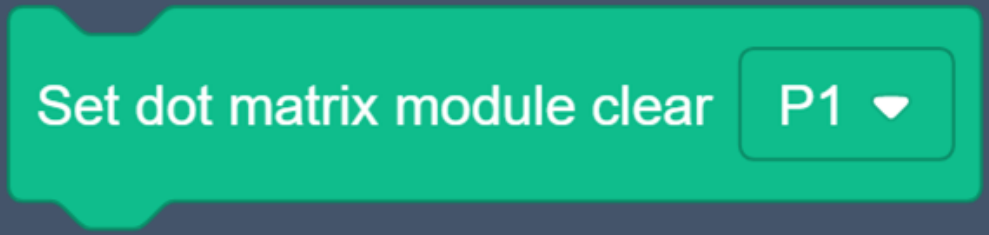
This program has been unanimously praised by rocket experts, who believe that it is very accurate, clear and scientifically highlights the dwindling time of the rocket launch, and makes people feel a sense of urgency before the rocket launch. Since then, "countdown" has been widely adopted, and has surpassed the scope of use, becoming a term with strong applicability and a wide range of applications.

Knowledge Introduction



Not only for rocket launches, we also need to use countdowns reasonably in our daily lives to precisely control things such as cooking, crossing the road, and trains entering stations. Today, we will use the dot matrix screen to make a precise countdown machine.

Programming module | Dot matrix screen - clear screen



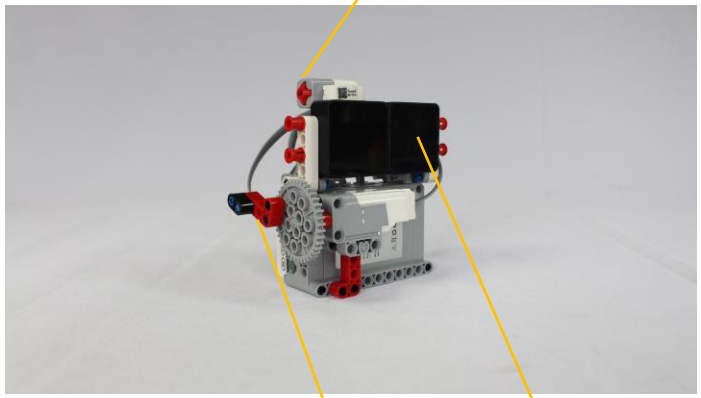
Using this module, all the lights of the dot matrix screen can be turned off.



Practice

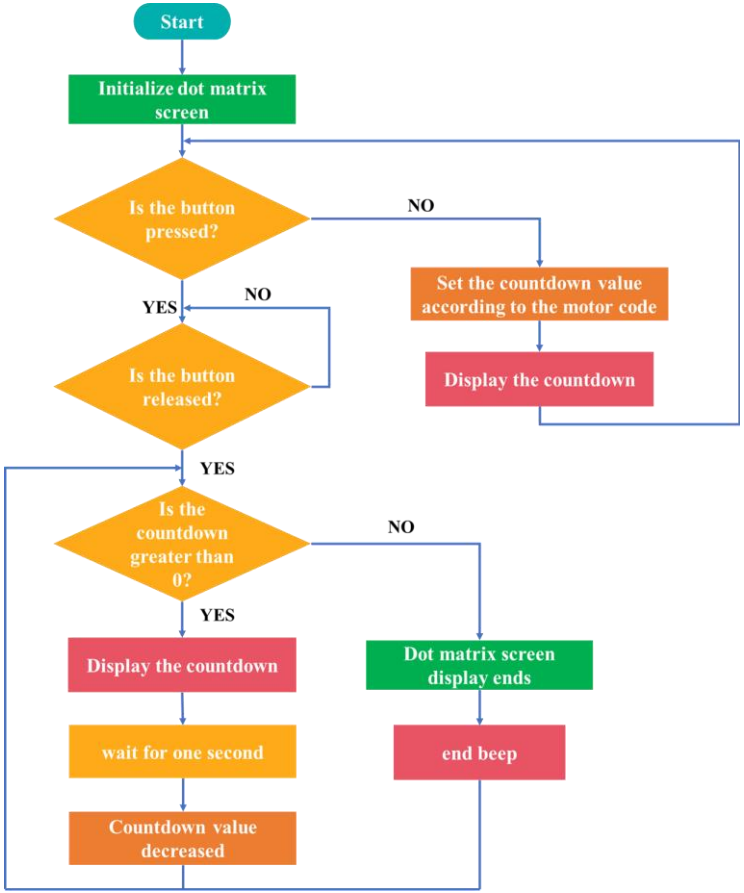


New Knowledge



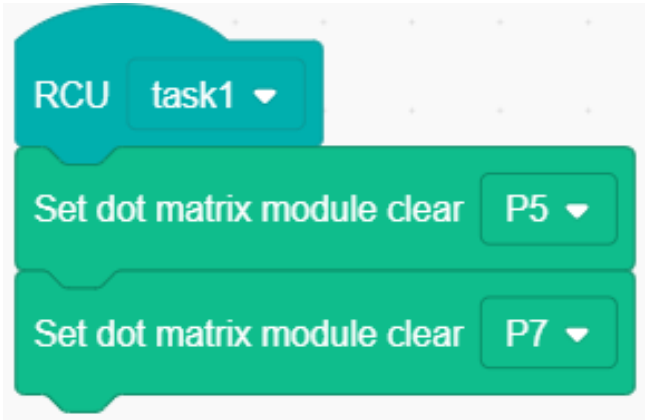
Build a countdown robot according to the building manual, and count down after entering the time.

Practice | Flow Chart



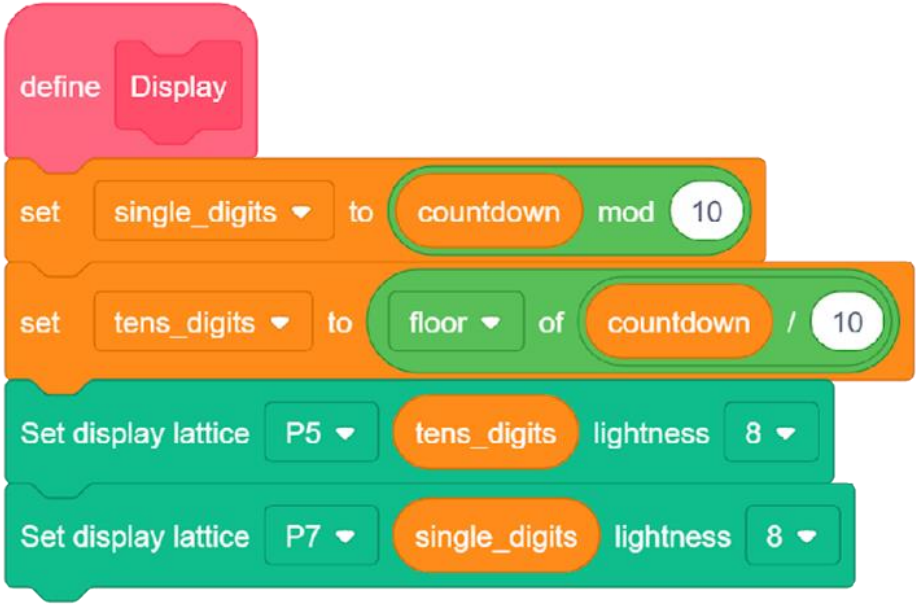
After shaking the motor, press the button to start timing. During the timing, the countdown number will be displayed and a prompt will sound at the end.

When displaying the countdown number, we need to split the countdown into tens digits and single digits to display separately.



Initial settings

Initialize the dot matrix screen settings and avoid other invalid data when starting the program again.



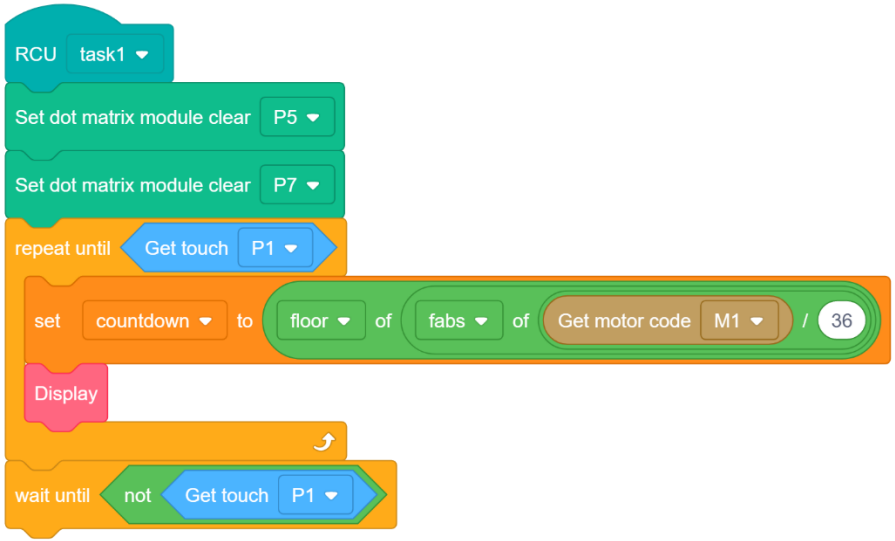
Function - Display

Define the "display" function, the single -digit is the remainder after dividing by 10, and the tens digit is the rounding down after dividing by 10.

Suppose the current countdown is 30, the single-digit displays 0, and the tens digit displays 3; when the countdown becomes 29, the single digit displays 9, and the tens digit displays 2.

Round down (floor) : take only the integer part of the value.

Practice | Programming

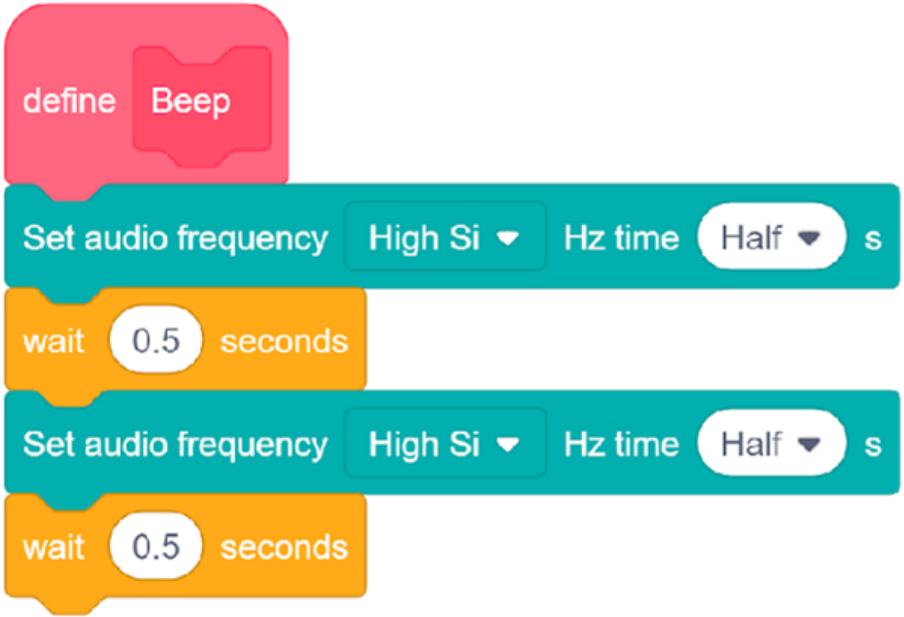


Judgment on whether to press the button

Button judgment is used to determine when to start the countdown. You can set the countdown value before pressing the key, and the countdown will start after pressing the key.

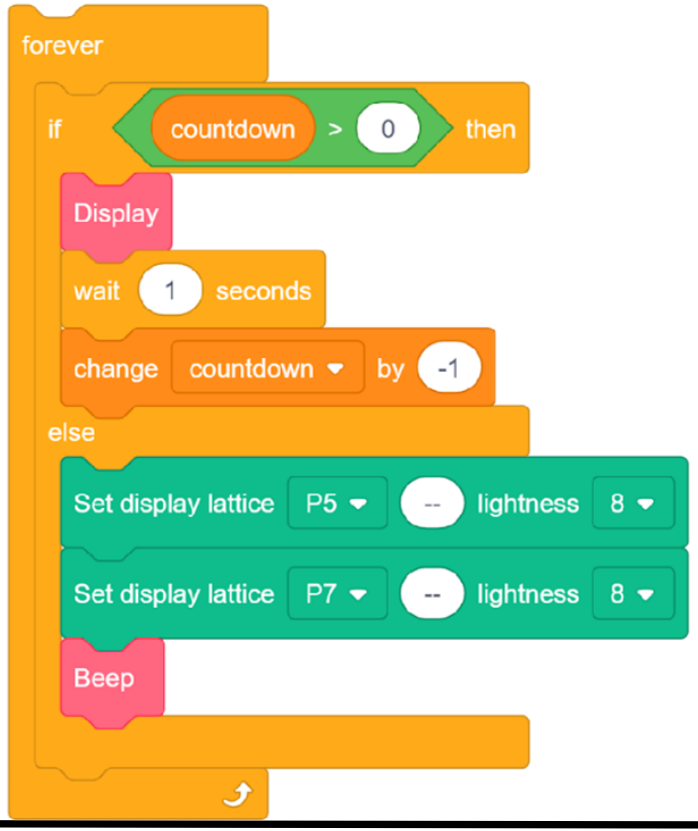
In order to avoid negative numbers in the countdown, it is necessary to perform absolute value calculations and then round down.

Absolute value operation: It does not distinguish between positive and negative values, and they are unified as positive numbers. Pay attention to distinguishing the concepts of absolute value operation and absolute value.



Function - Beep

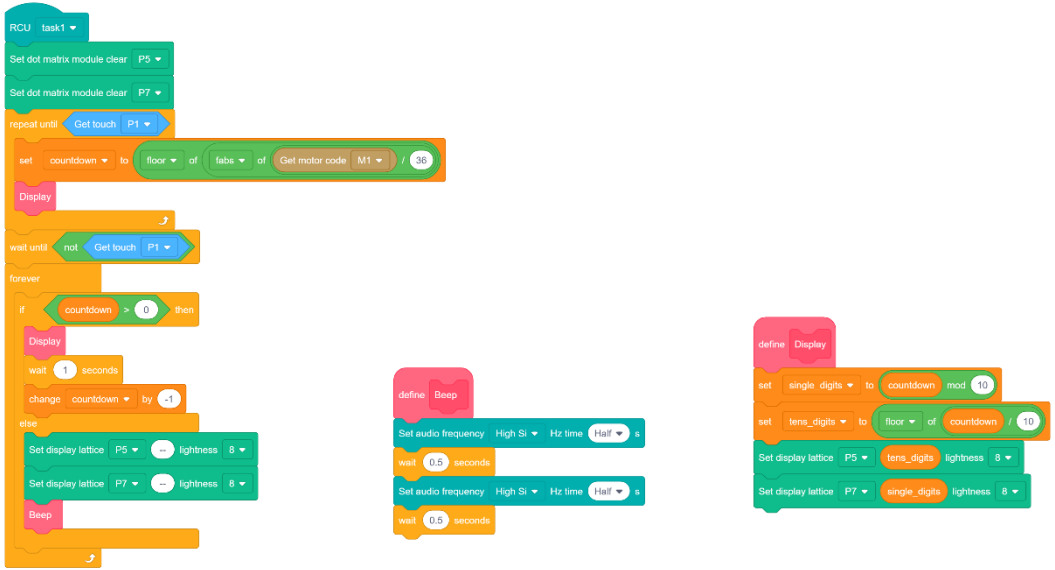
Create a beep function that sounds a "beep" every half a second.



The program of the countdown

Enter the countdown, and count down by 1 every second until the countdown returns to zero. During this process, the corresponding value is always displayed.

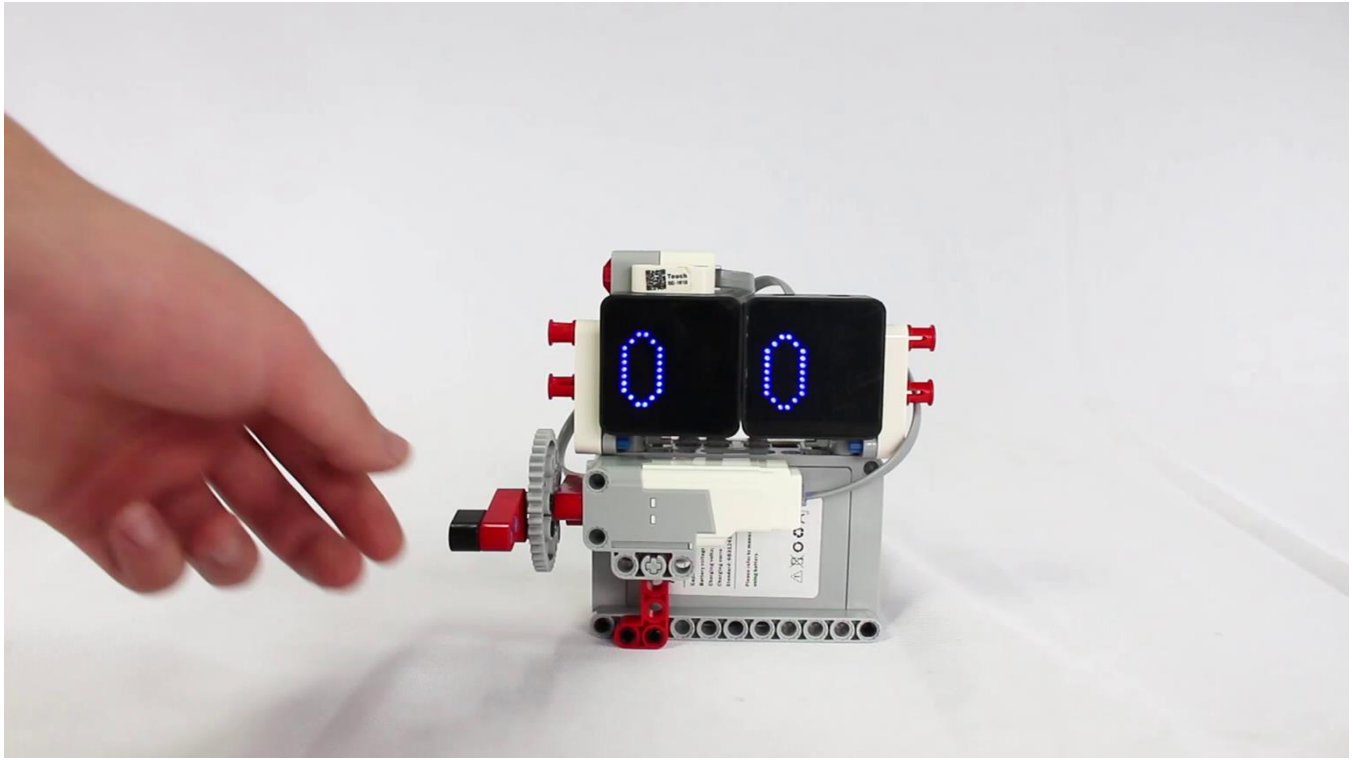
Practice | Programming

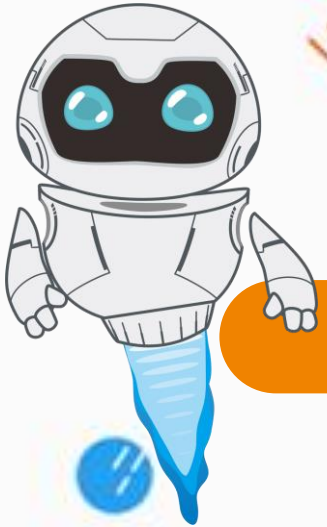


Integrate the program

Integrate the entire program according to the flowchart.

Practice | Programming





Results

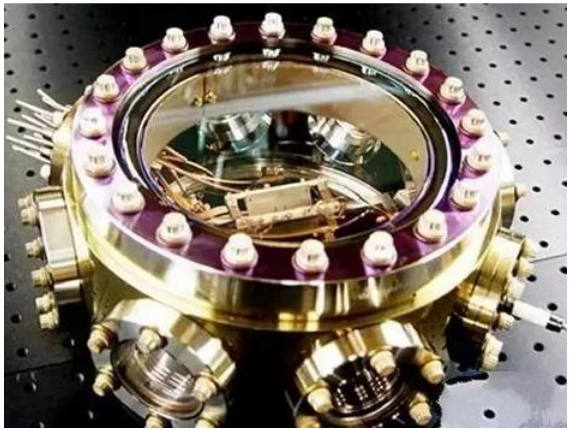
Program Optimization

This lesson realizes the countdown function displayed on the dot matrix screen. After setting the countdown time by rotating the motor, the program will start the countdown by itself.

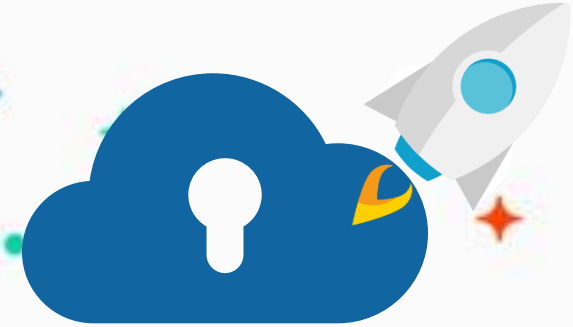
Next, modify the program to limit the countdown to three digits.

Requirements: Limit the maximum countdown to 99 to avoid display bugs.

Further Reading



The clocks and watches that people usually use have an error of about 1 minute per year with high precision, which has no effect on daily life, but more accurate timing tools are needed in demanding production and scientific research. At present, the most accurate timekeeping tool in the world is the atomic clock, which appeared in the 1950s. Atomic clocks keep time by using electromagnetic waves emitted when atoms absorb or release energy. Because this electromagnetic wave is very stable and controlled by a series of sophisticated instruments, the timing of atomic clocks can be very accurate. The elements currently used in atomic clocks include Hydrogen, Cesium, and Rubidium. Atomic clocks are accurate to only 1 second every 20 million years. This provides a strong guarantee for astronomy, navigation, and space navigation.



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Thanks!

LECTURER: