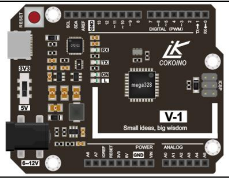
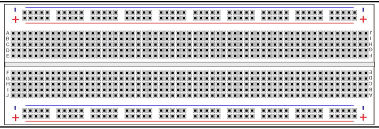
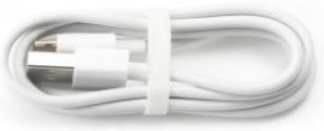
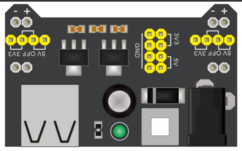
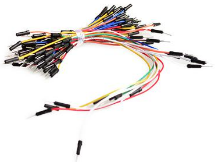
26.Make a digital clock

ABOUT THIS PROJECT：

You will learn：

- How to make a digital clock

1、Things used in this project

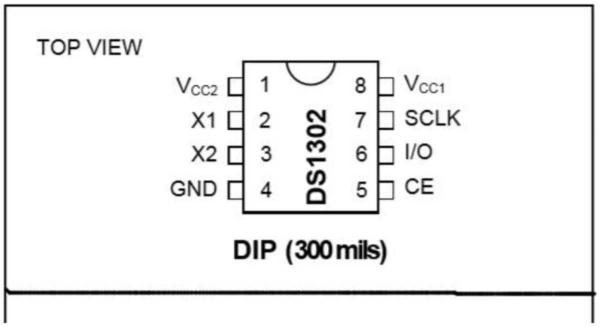
Hardware components	Picture	Quantity
V-1 board		1 PCS
Breadboard		1 PCS
Type C USB Cable		1 PCS
Breadboard power module		1 PCS
The DS1302 Trickle Charge Timekeeping Chip		1 PCS
Adjustable potentiometer		1 PCS
9V Battery Snap Connector		1 PCS
1602 LCD		1 PCS
Male to Male DuPont Line		22 PCS
Cylindrical crystal 32.768KHz		1 PCS

2、DS1302 clock chip

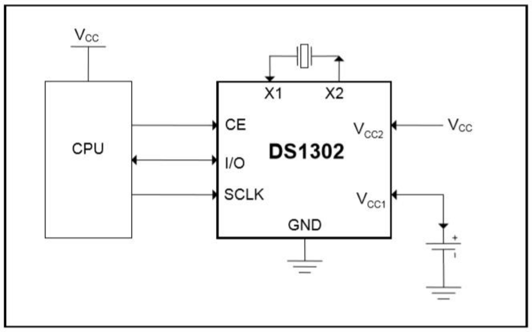
The DS1302 trickle-charge timekeeping chip contains a real-time clock/calendar and 31 bytes of static RAM. It communicates with a microprocessor via a simple serial interface. The real-time clock/calendar provides seconds, minutes, hours, day, date, month, and year information. The end of the month date is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The clock operates in either the 24-hour or 12-hour format with an AM/PM indicator.

Interfacing the DS1302 with a microprocessor is simplified by using synchronous serial communication. Only three wires are required to communicate with the clock/RAM: CE, I/O (data line), and SCLK (serial clock). Data can be transferred to and from the clock/RAM 1 byte at a time or in a burst of up to 31 bytes. The DS1302 is designed to operate on very low power and retain data and clock information on less than 1μW.

PIN CONFIGURATIONS



TYPICAL OPERATING CIRCUIT



PIN DESCRIPTION PIN NAME FUNCTION

1：VCC2

Primary Power-Supply Pin in Dual Supply Configuration. VCC1 is connected to a backup source to maintain the time and date in the absence of primary power. The DS1302 operates from the larger of VCC1 or VCC2. When VCC2 is greater than VCC1 + 0.2V, VCC2 powers the DS1302. When VCC2 is less than VCC1, VCC1 powers the DS1302.

2：X1

3：X2

Connections for Standard 32.768kHz Quartz Crystal. The internal oscillator is designed for operation with a crystal having a specified load capacitance of 6pF. For more information on crystal selection and crystal layout considerations, refer to Application Note 58: Crystal Considerations for Dallas Real-Time Clocks. The DS1302 can also be driven by an external 32.768kHz oscillator. In this configuration, the X1 pin is connected to the external oscillator signal and the X2 pin is floated.

4： GND Ground

5： CE Input. CE signal must be asserted high during a read or a write. This pin has an internal 40kΩ (typ) pulldown resistor to ground. Note: Previous data sheet revisions referred to CE as RST. The functionality of the pin has not changed.

6：I/O Input/Push-Pull Output. The I/O pin is the bidirectional data pin for the 3-wire interface. This pin has an internal 40kΩ (typ) pulldown resistor to ground.

7：SCLK Input. SCLK is used to synchronize data movement on the serial interface. This pin has an internal 40kΩ (typ) pulldown resistor to ground.

8： VCC1

Low-Power Operation in Single Supply and Battery-Operated Systems and LowPower Battery Backup. In systems using the trickle charger, the rechargeable energy source is connected to this pin. UL recognized to ensure against reverse charging current when used with a lithium battery.

Note:Refer to the data sheet provided for more information

3 Digital clock experiment

3.1 Code：

```
#include <stdio.h>
#include <DS1302.h>
#include <LiquidCrystal.h>
const int rs = 7, en = 6, d4 = 5, d5 = 4, d6 = 3, d7 = 2;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

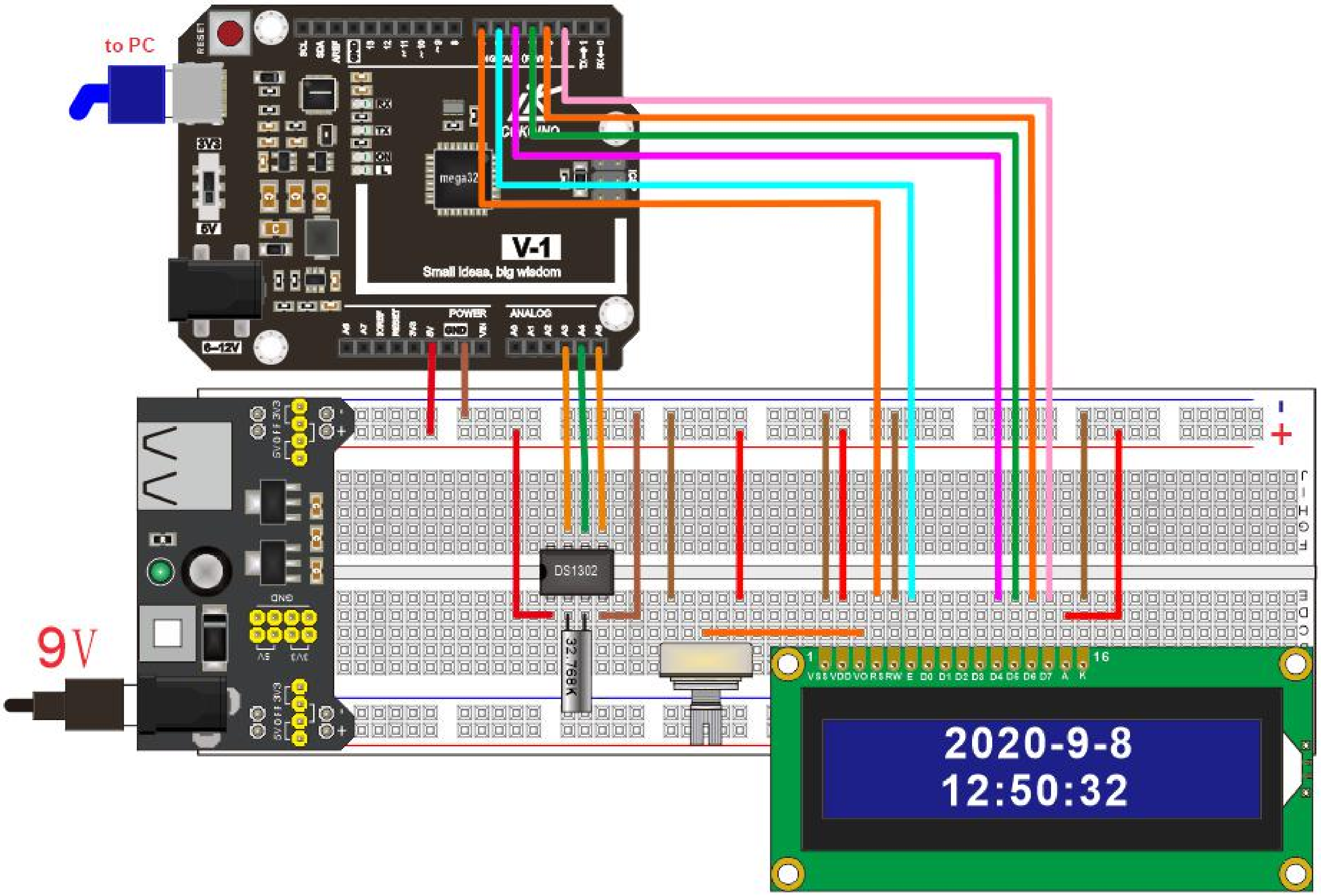
namespace {
const int kCePin   = A5;  // Chip Enable
const int kIoPin   = A4;  // Input/Output
const int kSclkPin = A3;  // Serial Clock
  // Create a DS1302 object.
  DS1302 rtc(kCePin, kIoPin, kSclkPin);

  String dayAsString(const Time::Day day) {
    switch (day) {
      case Time::kSunday: return "Sunday";
      case Time::kMonday: return "Monday";
      case Time::kTuesday: return "Tuesday";
      case Time::kWednesday: return "Wednesday";
      case Time::kThursday: return "Thursday";
      case Time::kFriday: return "Friday";
      case Time::kSaturday: return "Saturday";
    }
  return "(unknown day)";
  }

  void printTime() {
  // Get the current time and date from the chip.
  Time t = rtc.time();
  // Name the day of the week.
  const String day = dayAsString(t.day);
  // Format the time and date and insert into the temporary buffer.
  char buf[50];
  snprintf(buf, sizeof(buf), "%s %04d-%02d-%02d %02d:%02d:%02d",
           day.c_str(),
           t.yr, t.mon, t.date,
           t.hr, t.min, t.sec);
  // Print the formatted string to LCD so we can see the time.
  lcd.setCursor(3, 0);
  lcd.print(t.yr);
  lcd.print("-");
  lcd.print(t.mon);
  lcd.print("-");
  lcd.print(t.date);
  lcd.setCursor(0, 1);
  lcd.print("                ");
  lcd.setCursor(3, 1);
  lcd.print(t.hr);
  lcd.print(":");
  lcd.print(t.min);
  lcd.print(":");
  lcd.print(t.sec);
  }
}  // end namespace
```

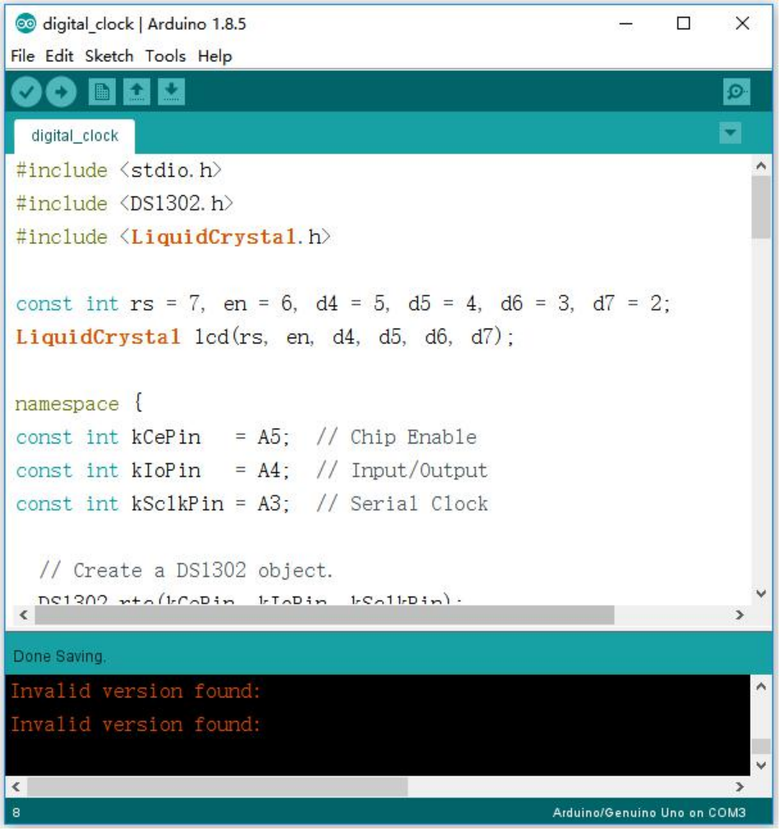
```
////////////////////////////////////////////////////////
void setup(){
   Serial.begin(115200);
   lcd.begin(16, 2);
   lcd.setCursor(1, 0);
   lcd.print("hello cokoino!");
   delay(1000);
   lcd.clear();
   // Initialize a new chip by turning off write protection and clearing the
   // clock halt flag. These methods needn't always be called. See the DS1302
   // datasheet for details.
   rtc.writeProtect(false);
   rtc.halt(false);
   // Make a new time object to set the date and time.
   // Sunday, September 8, 2020 at 12:38:10.
   Time t(2020, 9, 8, 12, 38, 10, Time::kSunday);
   // Set the time and date on the chip.
   rtc.time(t);
}
////////////////////////////////////////////////////////
void loop(){
   printTime();
   delay(1000);
}
```

3.2 Connection Diagram



3.3 Compile and upload

3.3.1 Use a USB cable to connect the computer to V-1 board, copy the above sample code to the arduino IDE, as shown below: (You must first copy the ds1302 library file attached to this course to the libraries folder)



```
#include <stdio.h>
#include <DS1302.h>
#include <LiquidCrystal.h>

const int rs = 7, en = 6, d4 = 5, d5 = 4, d6 = 3, d7 = 2;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

namespace {
const int kCePin   = A5;  // Chip Enable
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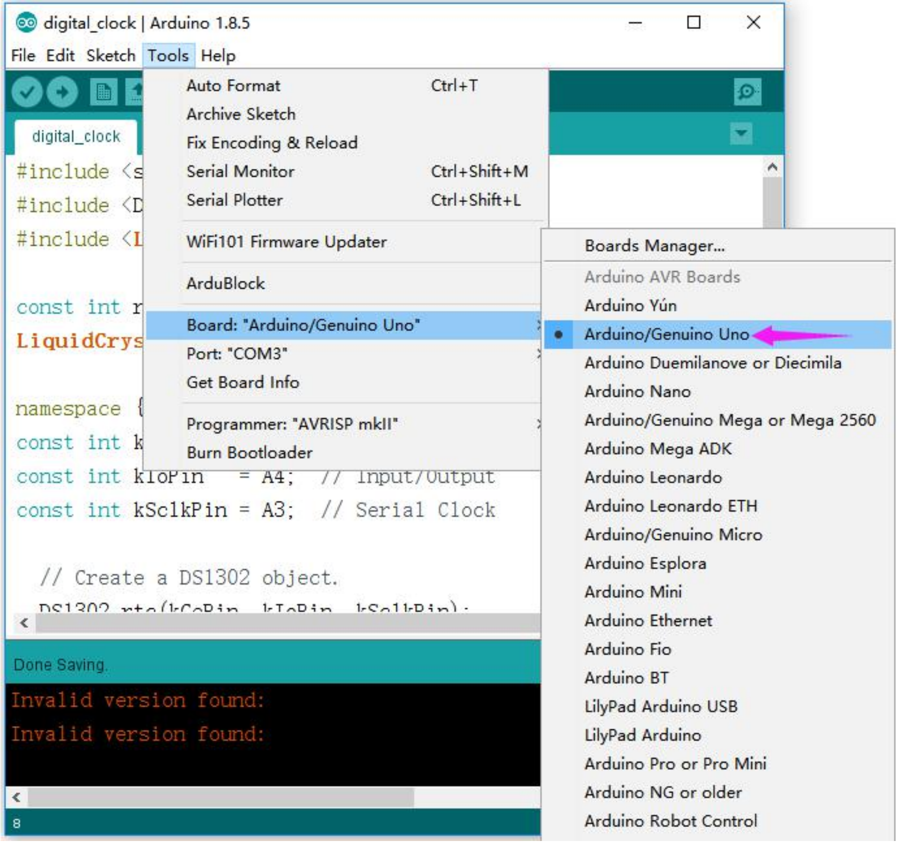
const int kSclkPin = A3;  // Serial Clock

  // Create a DS1302 object.
  DS1302 rtc(kCePin, kIoPin, kSclkPin);
```

```
Done Saving.
Invalid version found:
Invalid version found:
```

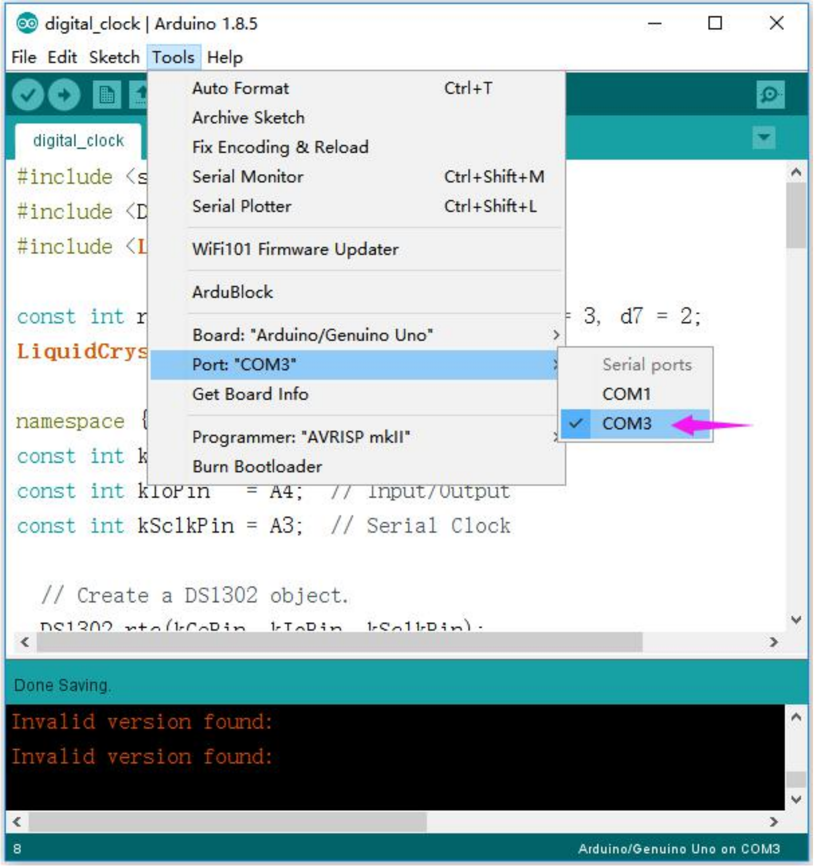
```
8                                                Arduino/Genuino Uno on COM3
```

3.3.2 select corresponding board type



```
Done Saving.
Invalid version found:
Invalid version found:
```

3.3.3 select corresponding port


digital_clock | Arduino 1.8.5
File Edit Sketch Tools Help
digital_clock
Auto Format Ctrl+T
Archive Sketch
Fix Encoding & Reload
Serial Monitor Ctrl+Shift+M
Serial Plotter Ctrl+Shift+L
WiFi101 Firmware Updater
ArduBlock
Board: "Arduino/Genuino Uno"
Port: "COM3"
Get Board Info
Programmer: "AVRISP mkII"
Burn Bootloader
Serial ports
COM1
COM3
Done Saving.
8
Arduino/Genuino Uno on COM3

```
#include <s
#include <D
#include <L

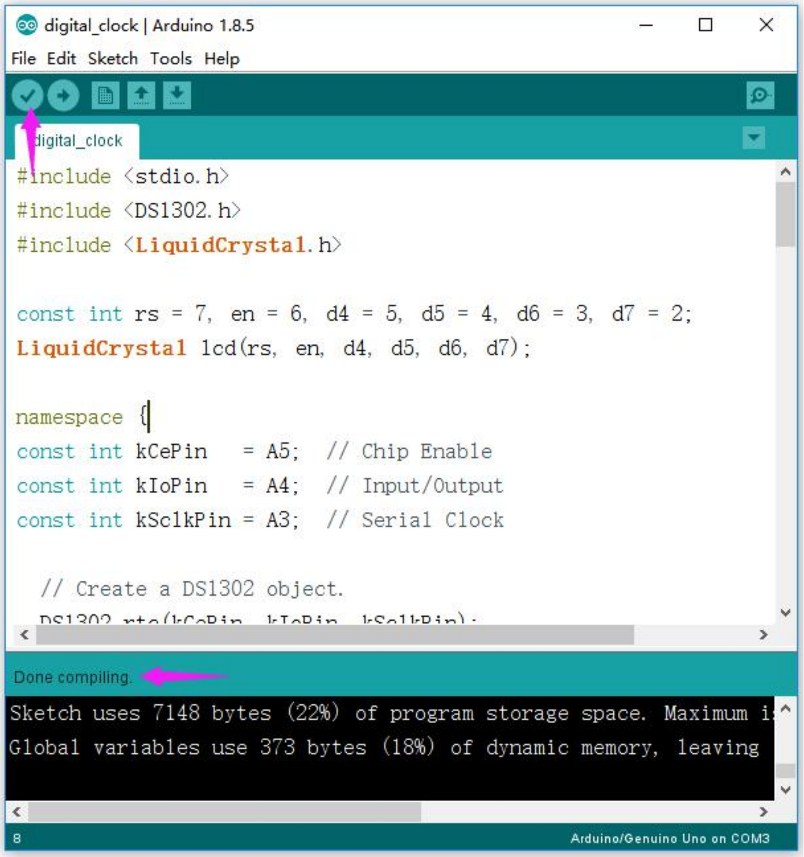
const int r                                   = 3, d7 = 2;
LiquidCrys

namespace {
const int k
const int kIoPin   = A4;  // Input/Output
const int kSclkPin = A3;  // Serial Clock

  // Create a DS1302 object.
  DS1302 rtc(kCePin, kIoPin, kSclkPin);
```

```
Invalid version found:
Invalid version found:
```

3.3.4 compile this sketch


digital_clock | Arduino 1.8.5
File Edit Sketch Tools Help
digital_clock
Done compiling.
8
Arduino/Genuino Uno on COM3

```
#include <stdio.h>
#include <DS1302.h>
#include <LiquidCrystal.h>

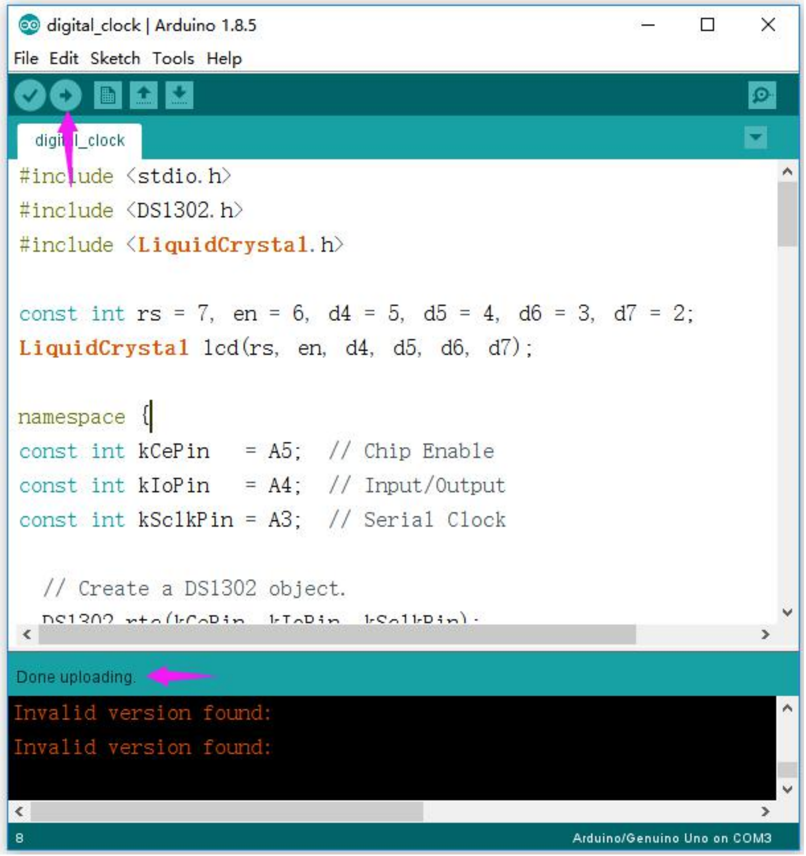
const int rs = 7, en = 6, d4 = 5, d5 = 4, d6 = 3, d7 = 2;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

namespace {
const int kCePin   = A5;  // Chip Enable
const int kIoPin   = A4;  // Input/Output
const int kSclkPin = A3;  // Serial Clock

  // Create a DS1302 object.
  DS1302 rtc(kCePin, kIoPin, kSclkPin);
```

```
Sketch uses 7148 bytes (22%) of program storage space. Maximum i
Global variables use 373 bytes (18%) of dynamic memory, leaving
```

3.3.5 simply click the “Upload” button in the environment


digital_clock | Arduino 1.8.5
File Edit Sketch Tools Help
digital_clock
Arduino/Genuino Uno on COM3

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#include <stdio.h>
#include <DS1302.h>
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const int rs = 7, en = 6, d4 = 5, d5 = 4, d6 = 3, d7 = 2;
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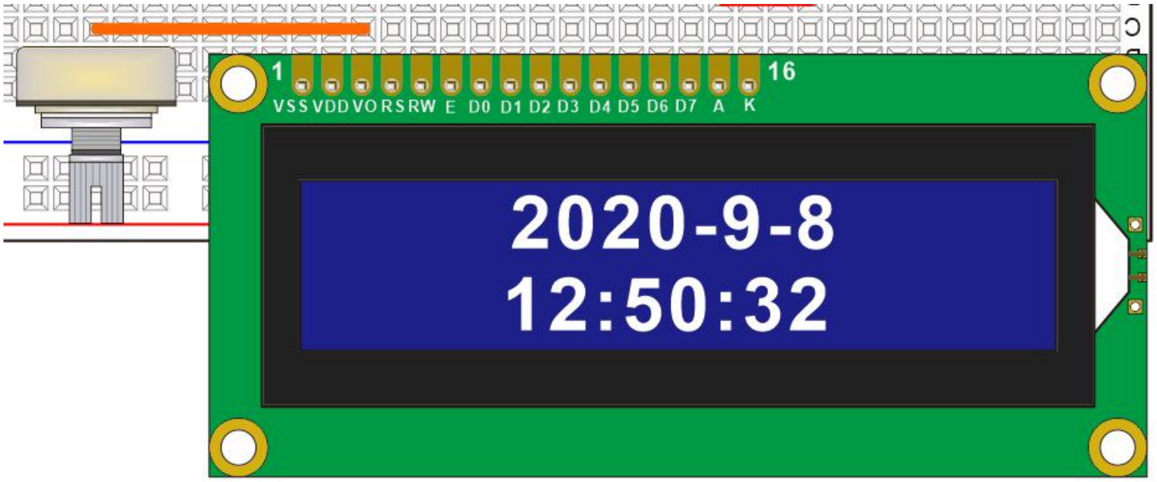
const int kSclkPin = A3;  // Serial Clock

  // Create a DS1302 object.
  DS1302 rtc(kCePin, kIoPin, kSclkPin);
```

Done uploading.

```
Invalid version found:
Invalid version found:
```

3.3.6 Unplug the USB cable from the V-1 board, then connect the power module with the external power supply and turn on the power switch，1602LCD will display the year, month, day, hour, second, and minute, as shown below:


1
16
VSS VDD VO RS RW E D0 D1 D2 D3 D4 D5 D6 D7 A K
2020-9-8
12:50:32