I2C: Part1

Ramin Zarebidoky (LiterallyTheOne)

29 Nov 2025

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Introduction

In the previous Tutorial, we learned about **Interrupt**. In this tutorial we will learn about **I2C** communication.

I2C Communication

Inter-Integrated Circuit (**I2C**), is a two-wire communication protocol. This protocol is designed for **short-distance communication** between microcontrollers and peripherals. It uses two pins to set up the communication:

- **SDA**: Serial Data
- **SCL**: Serial Clock

This way of communication, allows us to connect more than 1 component to the same 2 pins. For **I2C** every component has its own address. These addresses are mostly `7-bit`.

I2C is a master and slave protocol. It means that one device (Our Arduino) is a **master**, and the other devices are **slaves**. A **master** device controls the **clock** created in **SCL**. Also, **master** decides that if it wants to communicate with a **slave** or not. Each message of **master** is like below:

Field	Bit Count	Description
START	—	SDA goes LOW while SCL is HIGH → begins communication
Slave Address	7 bits	Unique address of target device (0–127)
R/W Bit	1 bit	0 = Write, 1 = Read
ACK/NACK	1 bit	Receiver pulls SDA LOW to acknowledge (ACK), HIGH for no-ack (NACK)

Field	Bit Count	Description
Data Byte 1	8 bits	First byte of data to write or read
ACK/NACK	1 bit	Receiver acknowledges the byte
Data Byte 2…N	8 bits	Additional data bytes (optional, depends on protocol)
ACK/NACK	1 bit	Acknowledge after each data byte
STOP	—	SDA goes HIGH while SCL is HIGH → ends communication

In the table above, you can see the message structure in **I2C**. First, **master** puts the **SDA** to low. This indicates that all **slaves** should listen. After that, it tells which **slave address** it wants to talk to. Then, with `1 bit` tells the **slave** if it wants to read or write. Next, there would be an acknowledgement bit. If **slave** was available, it would set the acknowledgement bit to `0`. (The default value of SDA is always `1`). After that, there would be a byte of data. Respect to the mode (read or write), **master** can send or receive that byte. Then, whoever receives the data, should set the acknowledgement bit to `0`. These byte transfer and acknowledgement can be repeated multiple times, until a stop signal. Stop signal can be created when we put the SDA to `1`.

To have a **I2C** communication in **Arduino** uno, we should use these pins:

signal	pin
SDA	`A4`
SCL	`A5`

Wire

To control the **I2C** communication, **Arduino** has a library called `Wire`. We can include `Wire` in our code like below:

```
#include <Wire.h>
```

To set up the **I2C** communication, we can use `.begin()` function, like below:

```
Wire.begin();
```

After doing that, we can start a communication with a **slave** in two ways:

- **write**
- **read**

To start a communication with a **slave** in order to **write**, we can use the code below:

```
Wire.beginTransmission(addr);   // start the communication in
 ↪  order to write with the slave with the address of `addr`
Wire.write(data);               // write data
Wire.endTransmission();         // finish transmission
```

If we want to our communication to be a **read** communication, we can

```
Wire.requestFrom(addr, number); // start a read communication
 ↪  with the slave with the address of `addr` and read `number`
 ↪  bytes
Wire.read();                    // read bytes
```

Let's connect an **I2C** component to the **Arduino** and check these functions.

Finding I2C address

- Connect the clock
- write the code
- Explain the code
- end transmission = 0

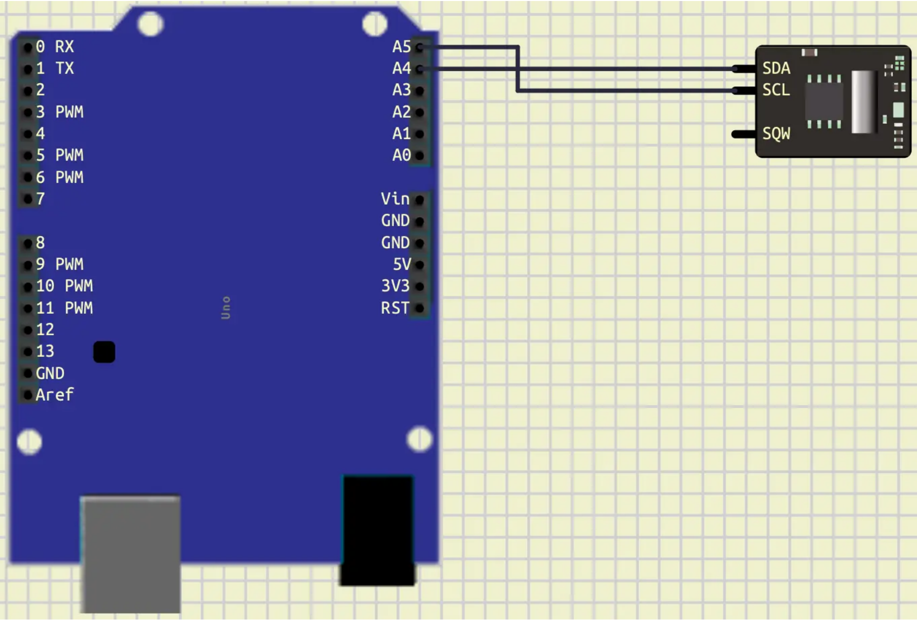


Figure 1: add-clock

```
#include <Arduino.h>
#include <Wire.h>
```

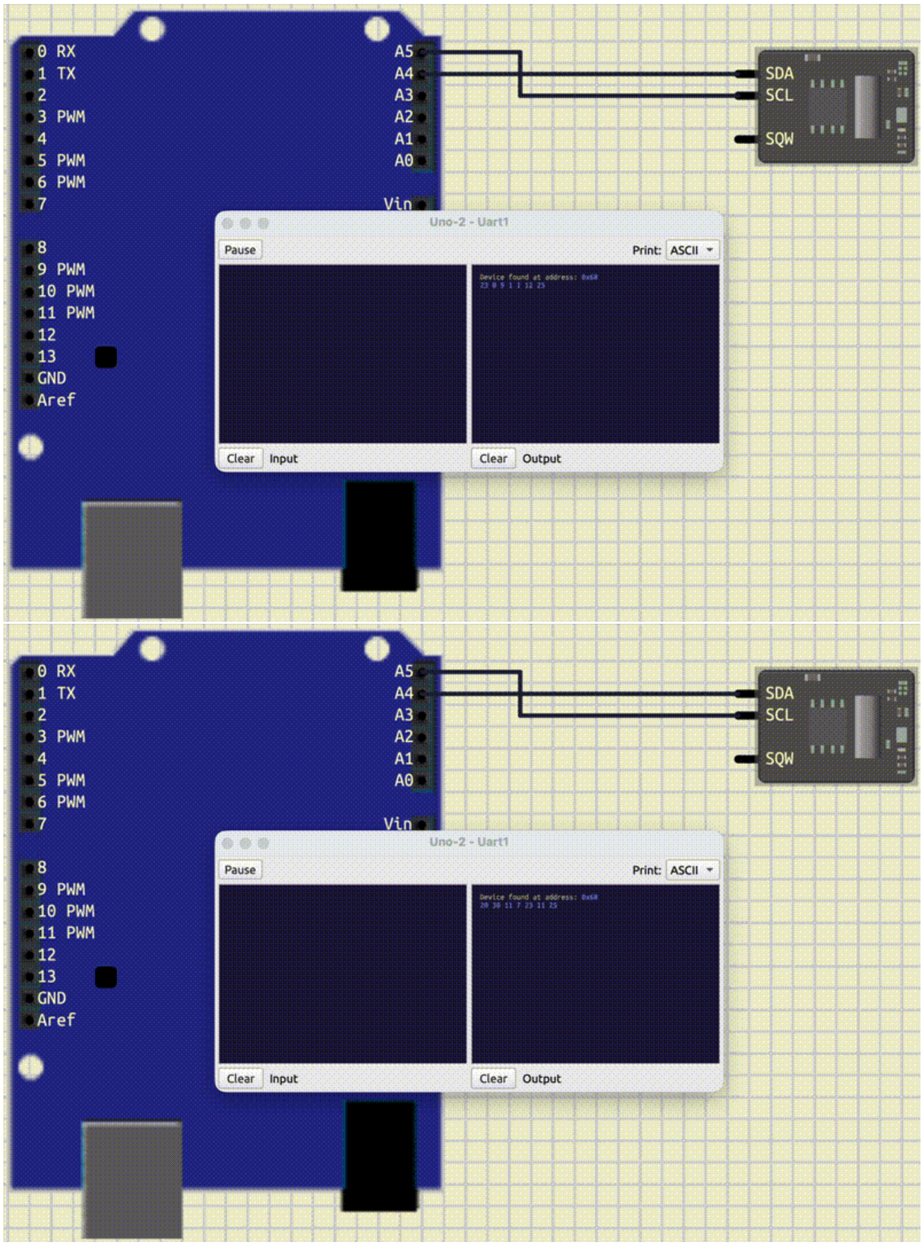
```
void setup()
{
  Wire.begin();
  Serial.begin(9600);
}

void loop()
{
  for (int i = 0; i < 127; i++)
  {
    Wire.beginTransmission(i);
    if (Wire.endTransmission() == 0)
    {
      Serial.println("Device found at address: 0x" + String(i,
 ↪  HEX));
    }
  }
  delay(2000);
}
```

Clock: DS1307

- Storing: 0x22 -> 22 not 2*16+2
- seconds, minutes, hours, weekday, day, month, year
- SQW: Square Wave Output
  - Good for creating interrupts

Register	Address
Seconds	0x00
Minutes	0x01
Hours	0x02
Day of Week	0x03
Day of Month	0x04
Month	0x05
Year	0x06



Link to the Datasheet

OLED: SSD1306

```
lib_deps =
    Adafruit SSD1306
```

```
Adafruit GFX Library
```

```
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>
```

```
#define SCREEN_WIDTH 128
#define SCREEN_HEIGHT 64

Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire);
```

```
if (!display.begin(SSD1306_SWITCHCAPVCC, SSD1306_ADDRESS))
{
Serial.println("SSD1306 failed!");
for (;;)
  ;
}

display.setTextSize(1);
display.setTextColor(WHITE, BLACK);
```

```
display.clearDisplay();
display.setCursor(0, 0);
```

```
display.print();
display.display();
```

Good Example

Project

Conclusion

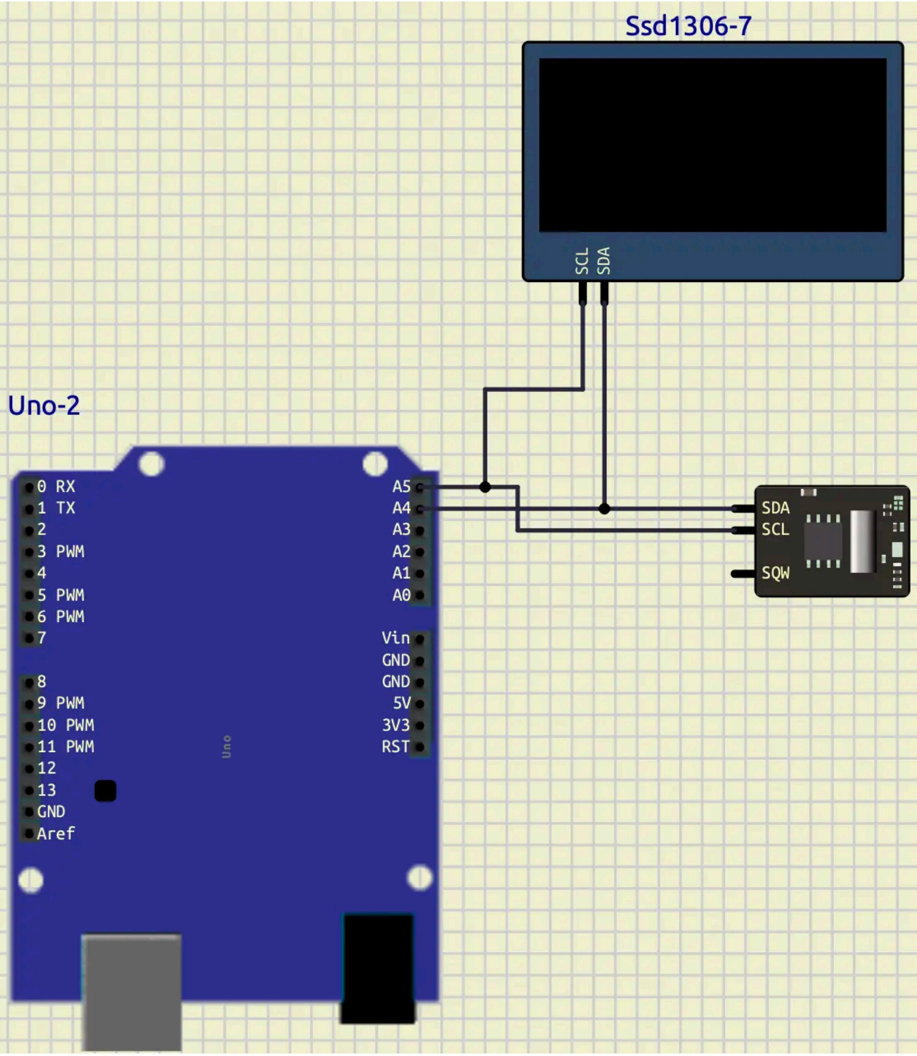


Figure 2: OLED

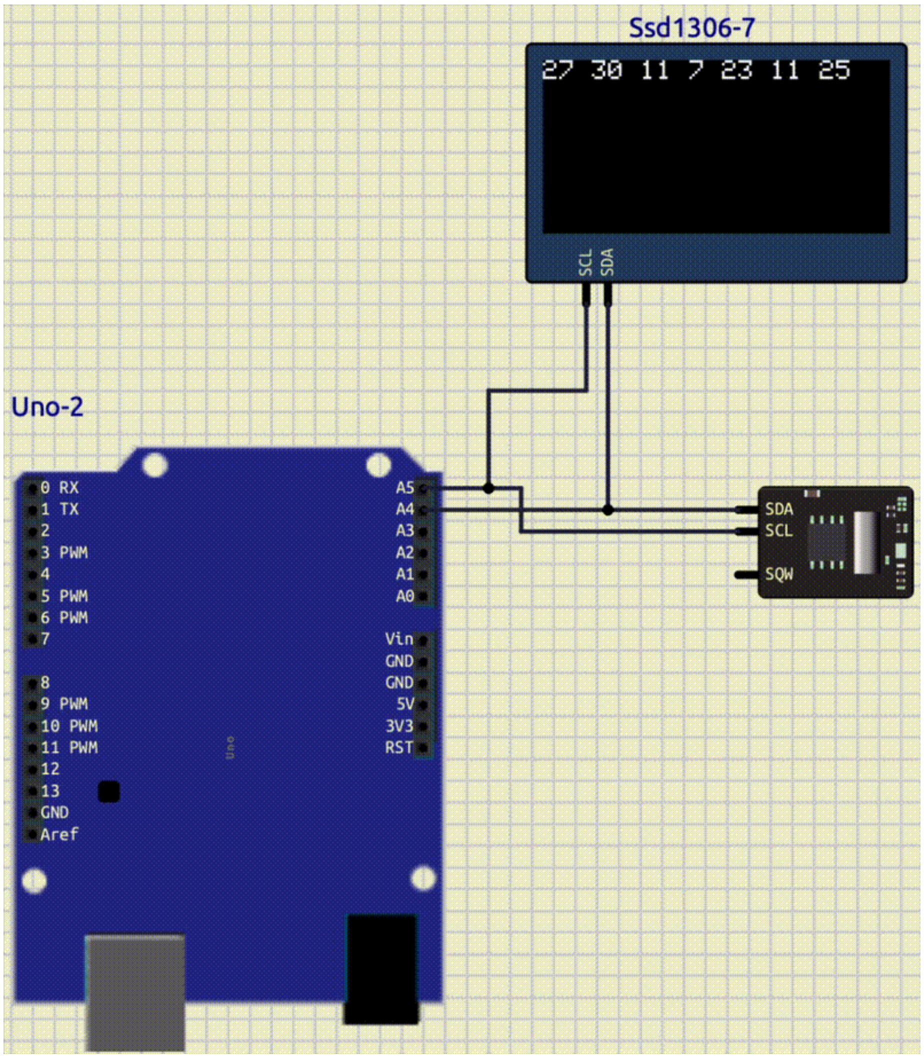


Figure 3: OLED gif

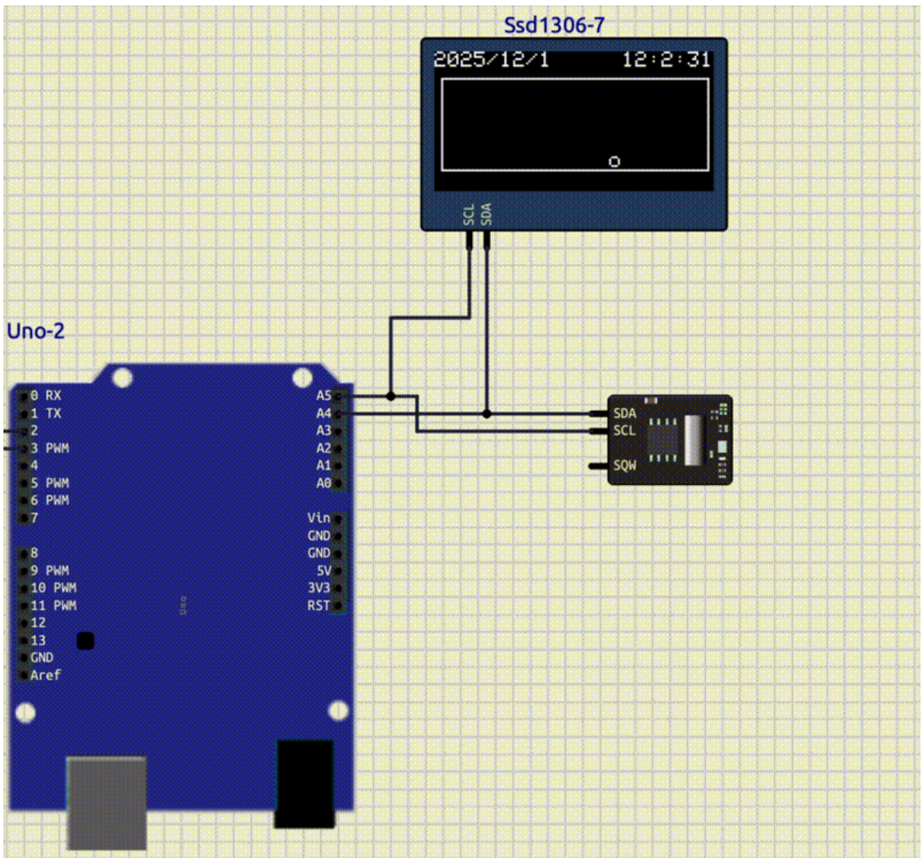


Figure 4: oled ball

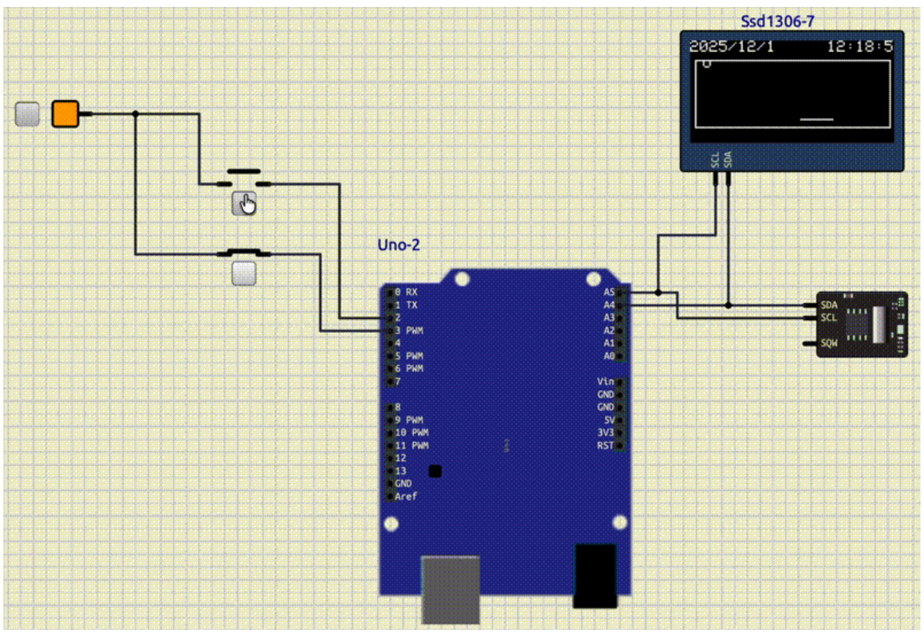


Figure 5: OLED Ball line