Serial

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Serial Communication

Introduction

In the previous tutorial, we learned how to work with **LCD** and **Keypad**. In this tutorial, we are going to learn about **Serial Communication** and some of its usages.

Serial communication

Serial communication is a way that a microcontroller can send and receive data one bit at a time. You can use it to communicate with computers, microcontrollers, and modules (e.g., GPS, Bluetooth, ESP8266). **Serial communication** is one of the most important concepts in microcontrollers. **Arduino Uno** uses **UART** (Universal Asynchronous Receiver-Transmitter) to handle the **Serial communication**. **UART** needs two pins, one for receiving data (RX) and one for transmitting data (TX). These two pins are available in **Arduino Uno** in **pin 0** (RX) and **pin 1** (TX). Also, we can have **Serial Communication** with **USB** as well. One of the most important things in having a **Serial Communication** is setting the correct **baud rate** for both of the devices that are trying to communicate. **Baud rate** indicates the speed of data transfer. The reason that **baud rate** should be the same for both devices is that, we have an **asynchronous** communication. The start and the end of the communication are determined with **start bit** and **end bit**.

Serial Terminal on SimulIDE

One of the ways that we can use **Serial communication** is by using a **Serial Terminal**. You can access a **Serial Terminal** in **Micro/Peripherals/Serial Terminal**. Now, let's put a **Serial Terminal** on the board and connect it to an **Arduino Uno**. To do that, we should wire them like below:

- **TX** of **Arduino** -> **RX** of **Serial Terminal**
- **RX** of **Arduino** -> **TX** of **Serial Terminal**

You should have something like this:

Serial Hello World

Now, let's create a **PlatformIO** project and write a **Hello World** for **Serial communication**. At first, let's initialize the **Serial Communication**. To do so, we can use the code below:

```
Serial.begin(9600);
```

In the code above, we set the **baud rate** of our **Serial communication** (default **baud rate** in **Serial Terminal** in **SimulIDE**) to 9600 and initialize the **Serial communication**. (To change the **baud rate** of the **Serial Terminal** in **SimulIDE** you can go to the properties of that **Serial Terminal**). Now, we are ready to write something on it. To do so, we can use the code below:

```
Serial.println("Hello World");
```

In the code above, we have printed `Hello World` into the serial port. The function `println`, prints the given input and makes a new line. Now, let's change our code in a way that it prints `Hello World` every one second. So we have the full code like below:

```
#include <Arduino.h>

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

void loop()
{
  Serial.println("Hello World");
  delay(1000);
}
```

Let's upload it into our **SimulIDE**. After pressing start simulation, you should click on the **open** button on the **Serial Terminal**. Your output would be something like below:

As you can see in the left panel **Hello World** is being printed constantly. Also, **Rx** on the terminal becomes **yellow** whenever it receives data.

Read from Serial Terminal

We have managed to send data to the **Serial Terminal**. Now, let's talk about how to read data from it. To do so we can use a function called `Serial.read()`. It would read the incoming **byte**. If there is no data, it would return `-1`. Also,

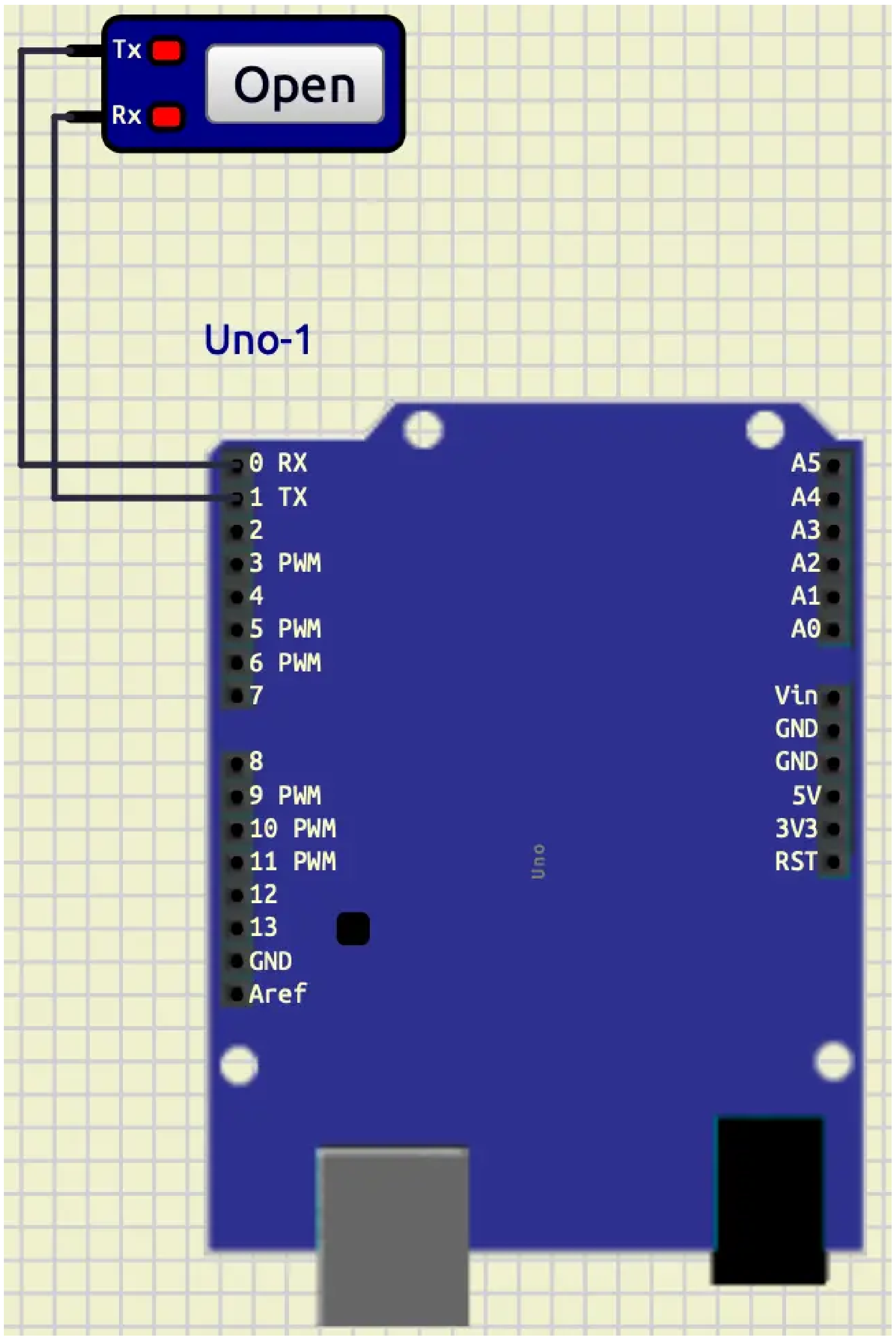
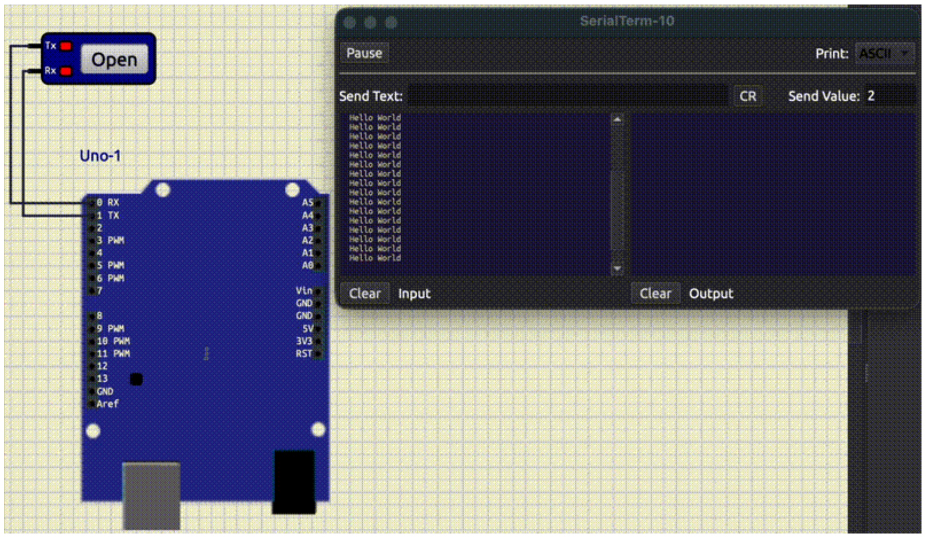


Figure 1: Serial Terminal



```
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
```

Figure 2: Hello World Serial

we have another function called `Serial.available()`. This function returns the number of bytes which are available for reading. So if we want to write a code that reads data and prints each character in separate lines, we can write something like below in the loop function:

```
if (Serial.available())
{
    char ch = Serial.read();
    Serial.println(ch);
}
```

The output would be something like below:

In the example above, I wrote **hello** and **world** separately. After I wrote down each one of them I pressed **Enter**. As you can see in the right panel, we can see the input that we sent to the **Arduino** and in the left panel we can see the response of the **Arduino**.

Read until new line

If we want to read the whole string, we can use a function called `Serial.readStringUntil`. This function reads the data in the buffer until it reaches the terminator that we give it as an argument. As a result it returns a **String**. So, if we want to change our code to read the whole line, we can change it like below:

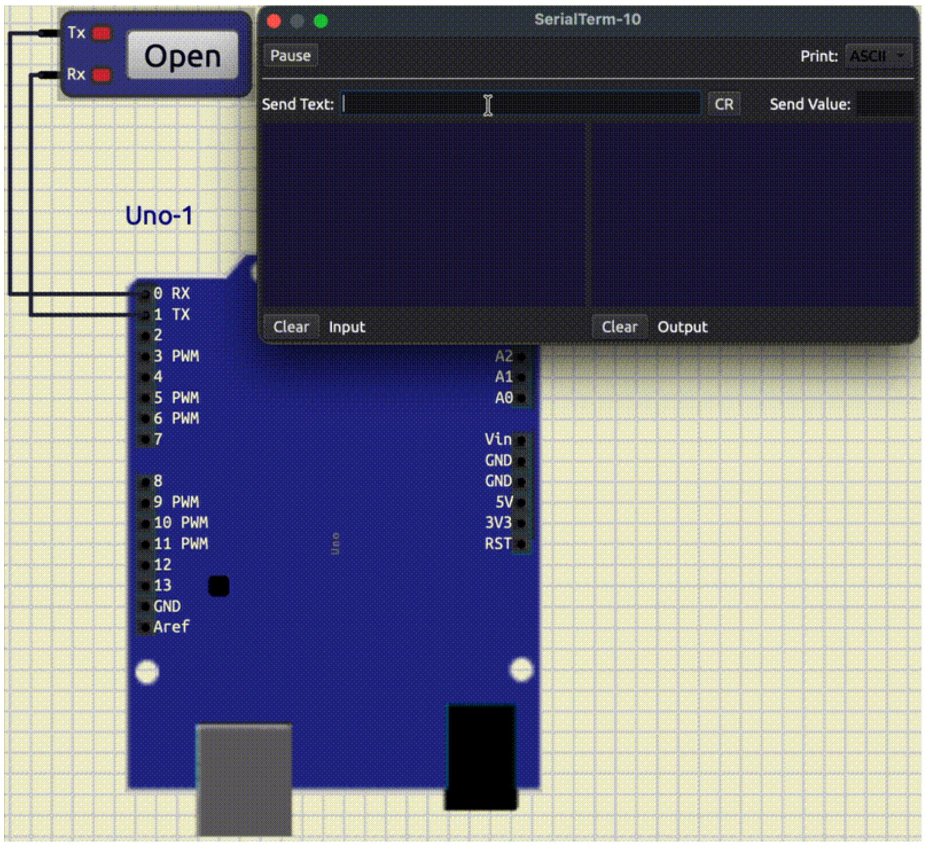


Figure 3: Serial Read

```
if (Serial.available())
{
    String result = Serial.readStringUntil('\n');
    Serial.println(result);
}
```

The output would be something like this:

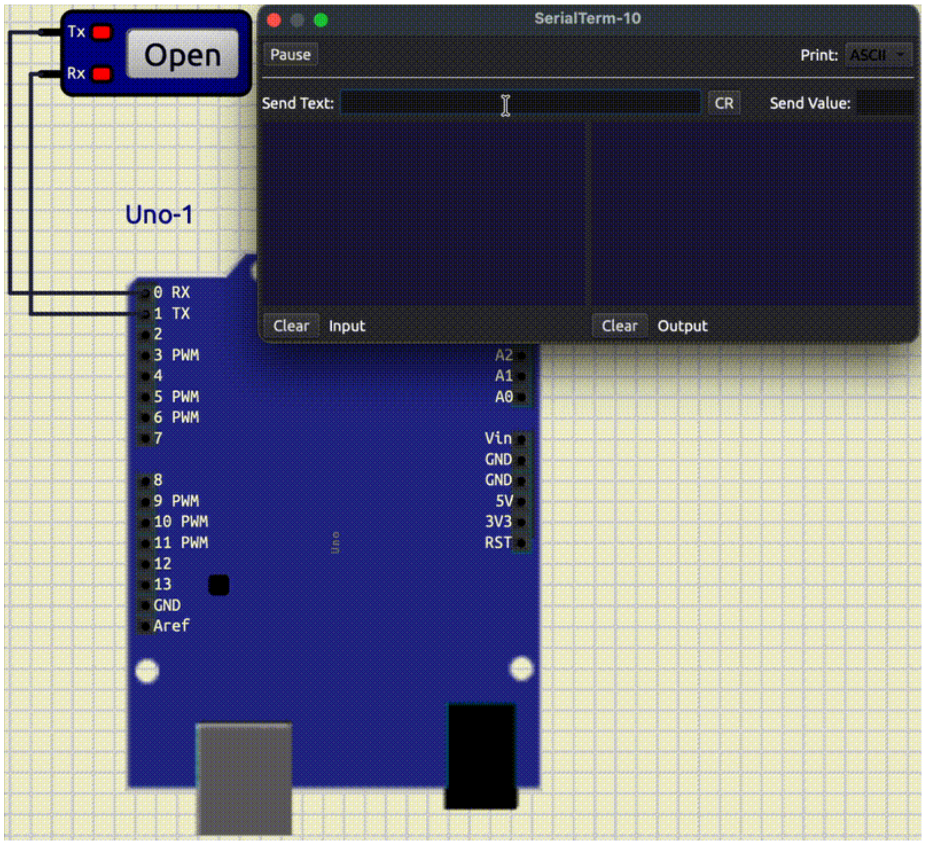


Figure 4: Serial Read String

As you can see, we write a whole sentence and when we press enter after some time it would print us the result.

Built-in Serial Monitor in SimulIDE

For debugging purposes, **SimulIDE** has implemented a **Serial Monitor** that you can see the transmitted and received data through that. To access it, you can right-click on the **Arduino Uno** then select **mega328/Open Serial Mon-**

itor/USart.

Software Serial

The built-in pins for **Serial Communication** in **Arduino Uno** are **pin 0, 1**. This is managed by hardware. If you want to use other pins for the **Serial communication**, you should use a package called `SoftwareSerial`. You can import it like below:

```
#include <SoftwareSerial.h>
```

To tell the `SoftwareSerial` which ports you need, you should make an object like below:

```
SoftwareSerial mySerial(10, 11); // RX, TX
```

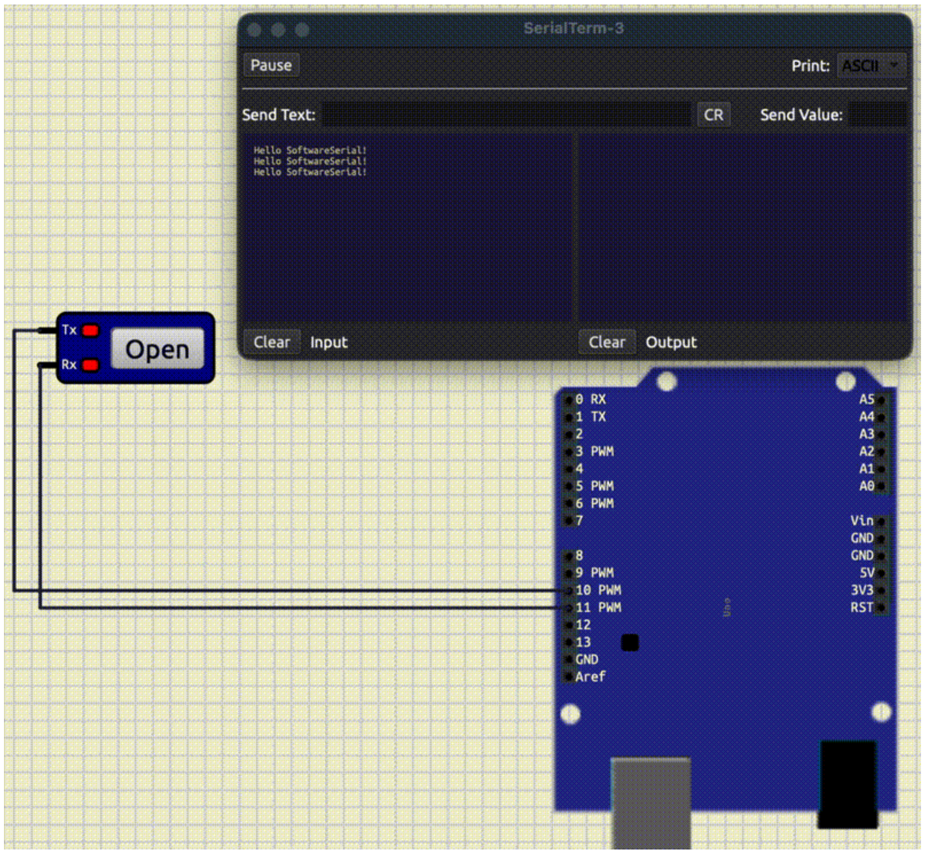
In the code above, we have used **pin 10** for **RX** and **pin 11** for **TX**. Now, we are ready to connect the device that we want to communicate with to **pin 10 and 11** and start our **Serial communication** as we would before. The whole code for a **Hello World** example is like this:

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

SoftwareSerial mySerial(10, 11); // RX, TX

void setup()
{
  mySerial.begin(9600);
}

void loop()
{
  mySerial.println("Hello SoftwareSerial!");
  delay(1000);
}
```

Your output should look like below:

Counter on two Arduinos

Now, that we know how two devices can communicate using **Serial communication**, let's connect two **Arduinos** together. We add a **Keypad** to the first **Arduino**. Its job is to receive a number and send it to the second Arduino. Then, we add an **LCD** to the second Arduino. Its job is to count down the number that it received to `0`. Your output should look like this:



```
Hello SoftwareSerial!
Hello SoftwareSerial!
Hello SoftwareSerial!
```

Figure 5: Software serial

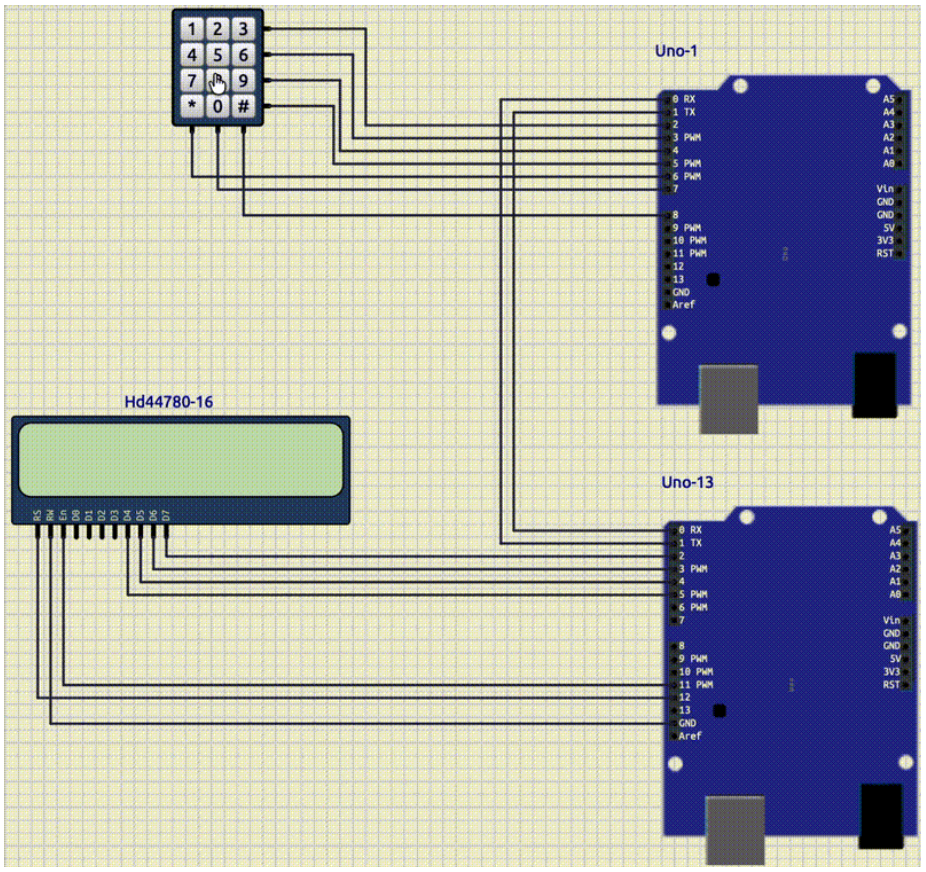


Figure 6: Two Arduinos

Conclusion

In this tutorial we walked through the concepts of **Serial Communication**. First, we explained the **Serial Communication**. Then, we provided an example on how to write with it. After that, we learned how to read from it. Next, we explained about `SoftwareSerial` and how to make other pins to work as a **Serial communication** pins. Finally, we provided an example with two arduinos to make you understand the concepts better.