BLUEIO832-MINI

User Guide

Abstract

We provide a brief overview of the features of BlueIO832-Mini and its specifications. Next, we present the steps of setting up BlueIO832-Mini as a serial interface bridge between BlueIOTerm mobile application and an arbitrary physical device. Finally, we introduce the users the resources for self-developing their own firmware on the BlueIO832-Mini.

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Contents

Revision History

Table 1. Document Revision

Revision no.	Description	Data	Prepared by	Approved by
1.0	2nd draft	Aug 15, 2022	Duy Thinh Tran	

I. Overview to BlueIO832-Mini

a. Key features of BlueIO832-Mini and the BlueIO ecosystem

The BlueIO832-Mini and the free BlueIO mobile apps suite constitute to the I-SYST BlueIO ecosystem. This versatile Internet-of-Thing (IoT) framework enables users, from their mobile device such as a smart phone, to remotely communicate with an arbitrary physical device - referred to as a *target device* in this document (Fig. 1). BlueIO832-Mini and BlueIO mobile app are considered as a data bridge and a data terminal, respectively. After connecting to the target device via a desired serial interface, BlueIO832-Mini streams the data on that physical interface to the BlueIO mobile app over Bluetooth® 5 protocol. BlueIO832-Mini provides four built-in app-configurable features of data communications with a target device:

- **[1] Serial interface bridge: (i)** Connect BlueIO832-Mini to a serial interface (UART, I2C, or SPI) of a target device. **(ii)** Pair BlueIO832-Mini with BlueIO mobile app on a mobile device. **(iii)** Configure the serial interface setting in BlueIO mobile app. **(iv)** Use BlueIO mobile app to remotely send and receive data on this interface.

- **[2] GPIO functions: (i)** Use BlueIO mobile app to configure pins of BlueIO832-Mini as GPIO for sending/receiving signal to/from a target device. **(ii)** Pair BlueIO832-Mini with BlueIO mobile app on a mobile device. **(iii)** Use BlueIO mobile app to send/receive signals(s) to/from the GPIO pin(s).

- **[3] Analog-to-Digital Converter (ADC): (i)** Use BlueIO832-Mini to convert (up to 3) analog signals to digital signals. **(ii)** Pair BlueIO832-Mini with BlueIO mobile app on a mobile device. **(iii)** Use BlueIO mobile app for monitoring the converted digital signals.[1]

- **[4] NFC tag:** BlueIO832-Mini can be used as an NFC tag once a Nordic®-compatible NFC antenna is plugged into the NFC connector. [2]

Besides that, BlueIO832-Mini can be used as an **IoT embedded development kit** for developing the user's own firmware by using Nordic® SDK. However, we recommend the user to use our open-source library **IOsonata**, which is built upon the Nordic® SDK, for faster and easier developing firmware on BlueIO832-Mini and any other Nordic® nRF52x SoC-based embedded system. Here are useful references for the IOsonata SDK and the guides on firmware development with IOsonata:

- IOsonata is available on this Github link.
- The steps of developing firmware with IOsonata SDK are available on this blogpost.
- For debugging the firmware built upon IOsonata in Eclipse® IDE, please refer to this blogpost.

Note 1, 2: *Feature [3] and [4] are not enabled in the current built-in firmware version.*

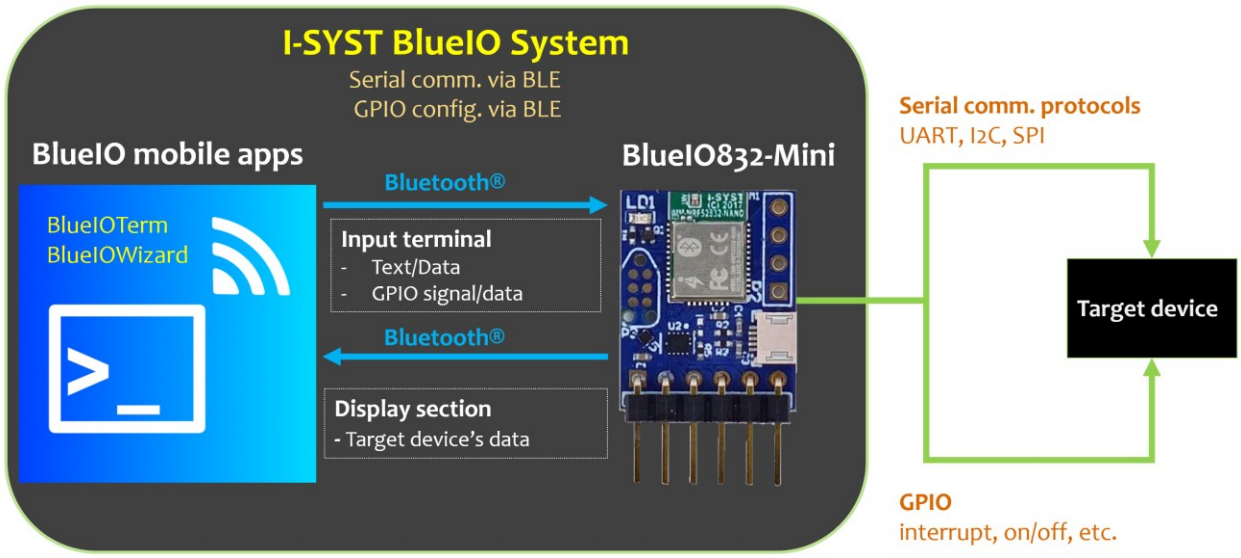


Fig. 1. The I-SYST BlueIO system with BlueIOTerm mobile app and BlueIO832-Mini hardware module.

b. Hardware Specification and Pin Layout

The heart of BlueIO832-Mini is the **I-SYST BLYST Nano** System-on-Module (SoM) built upon the Nordic® nRF52832 System on Chip (SoC), which is an ultra-low power 2.4 GHz wireless SoC. This Soc is equipped with 64 MHz ARM® Cortex®-M4F processor, 64 KB RAM, 512 KB flash memory. The SoC provides several serial interfaces such as UART, I2C, SPI and especially the Bluetooth® 5 low-energy mode. For more details of the I-SYST BLYST Nano, please refer to this webpage. The detail specifications of Nordic® nRF52832 SoC can be downloaded from the Nordic's website.

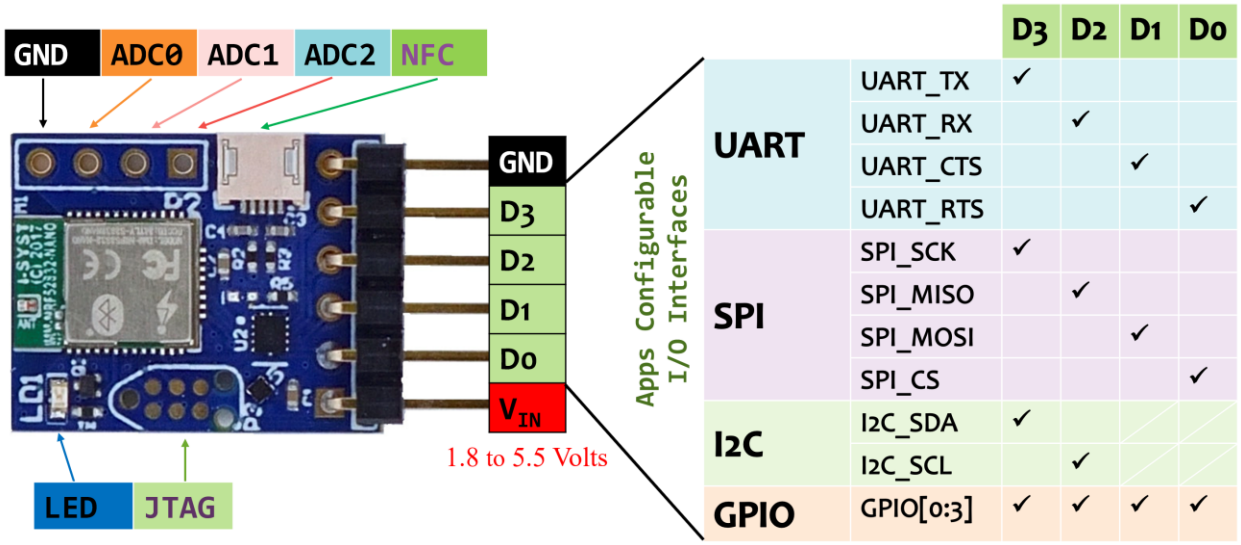
BlueIO832-Mini supports:

- Bluetooth® 5 low energy (BLE) mode
- A wide range of supply voltage ranging from 1.8 to 5.5 volts [V_{IN}]
- Internal level shifter supporting GPIO voltage matching the supply voltage
- 4 x pins [D0 – D3] which can be configured (via BlueIOWizard mobile app) as
    - 1 x UART
        - Baud rates up to 1000000 (1M baud)
        - Hardware flow control
        - Bit parity
    - 1 x I2C master
        - 100 kbps, 250 kbps, 400 kbps
    - 1 x SPI master
        - 125 kbps, 250 kbps, 500 kbps
        - 1 Mbps, 2 Mbps, 4 Mbps, 8 Mbps
    - 4 x GPIO with configurable parameters:
        - Direction
        - Drive strength
        - Pull-up/pull-down resistors enabling
        - Pin sensing

- 3 x Configurable ADC channels [ADC0 – ADC2]
  - Max input voltage 1.8V
  - 12-bit resolution
  - 1 differential mode
  - 3 independent channels
- NFC antenna socket
  - Works with any Nordic®-compatible NFC antenna
- JTAG
  - A 6-pin JTAG connector on the front side
  - An ARM® 10-pin CoreSight® JTAG connector on the back side

The pins and connectors layout of BlueIO832-Mini are shown in Figs. 2 and 3.

Depending on the use case and the specifications of the user's target device, pins D1-D4 on BlueIO832-Mini can be configured for UART, SPI, I2C or GPIO by using BlueIOWizard mobile app. Please follow Figs.2 and 3 for the appropriate pin assignment.



		D3	D2	D1	D0
UART	UART_TX	✓			
	UART_RX		✓		
	UART_CTS			✓	
	UART_RTS				✓
SPI	SPI_SCK	✓			
	SPI_MISO		✓		
	SPI_MOSI			✓	
	SPI_CS				✓
I2C	I2C_SDA	✓			
	I2C_SCL		✓		
GPIO	GPIO[0:3]	✓	✓	✓	✓

Fig. 2. Pin layout of BlueIO832-Mini on the front side

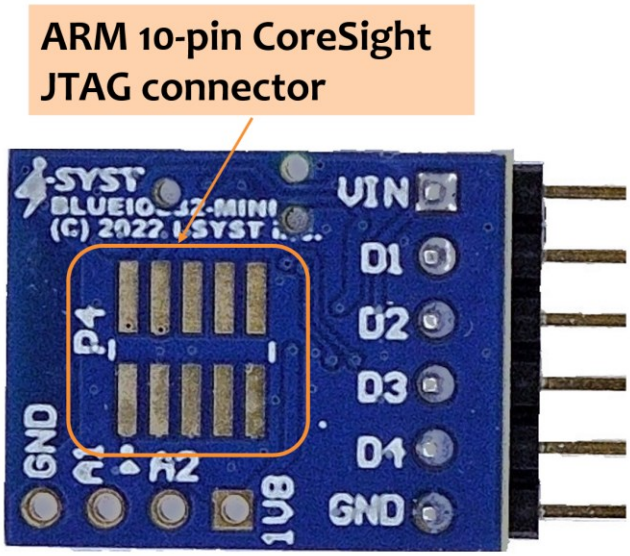


Fig. 3. Pin layout of BlueIO832-Mini on the back side

II. BlueIO Mobile Apps

In our BlueIO ecosystem, we provide a set of multi-platforms BlueIO mobile apps tailored for different use cases of the BlueIO832-Mini. These mobile apps can be installed on smartphones, smartwatches, and tablets. Table I presents the use cases of each mobile app. Table II presents the availability of the mobile apps on different the platforms.

Table 2. BlueIO mobile apps and the use cases

App Name	Use Cases					Pin configurable
	UART	SPI	I2C	GPIO	ADC	
BlueIOTerm	✓					No (*)
BlueIOSpi		✓				No
BlueIOI2c			✓			No
BlueIOAdc					✓	No
BlueIOWizard	✓	✓	✓	✓		Yes - App configurable

(*): The pins are pre-configured as in Fig. 2.

Table 3. BlueIO mobile apps and their support platforms

App Name	Smart Phone		Tablet	
	Apple® iOS	Android	Apple® ipadOS	Android
BlueIOTerm	✓	✓	✓	✓
BlueIOSpi				
BlueIOI2c				
BlueIOAdc				
BlueIOWizard				

III. An Example of Using BlueIOTerm Mobile App with BlueIO832-Mini

We illustrate an example using BlueIOTerm and BlueIO832-Mini for communicating with a target device over its UART interface. Here, the target device is a serial port app on a computer, which is then connected to BlueIO832-Mini via a USB-UART adapter. We demonstrate how to send text between the BlueIOTerm mobile app and the serial port app, typically CoolTerm, on a computer (Fig. 4).

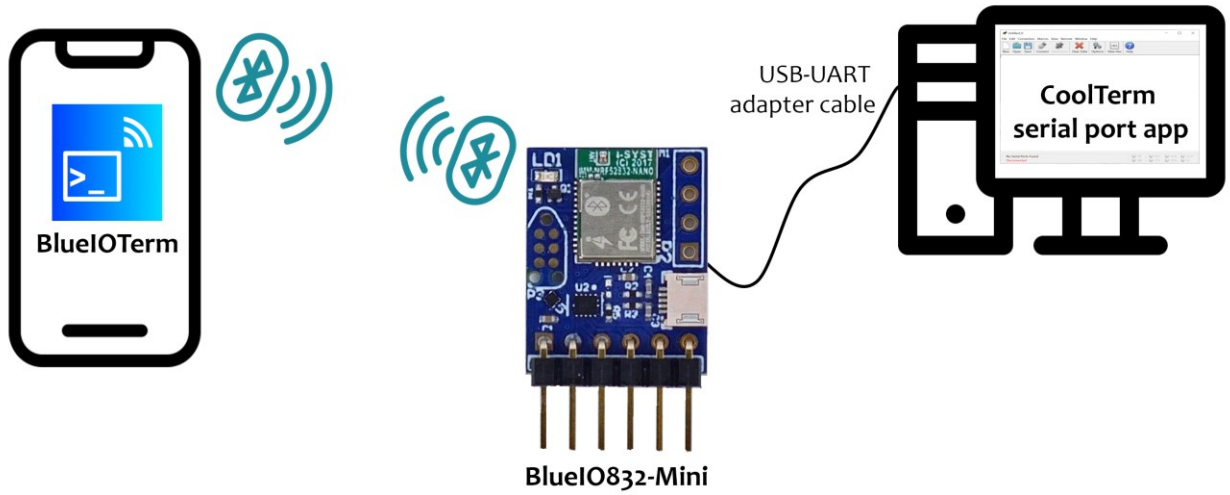


Fig. 4. Example setup.

The BlueIOTerm mobile app can be downloaded using the QR codes here or the links in Reference section.

BlueIOTerm app on Apple Store

BlueIOTerm app on Google Play

The CoolTerm serial port app can be downloaded here: https://freeware.the-meiers.org/

The steps are as follows:

1. Connect BlueIO832-Mini to the USB-UART adapter

(i) Identify the pins of the UART port of the USB-UART adapter. Here Green cable is UART_TX and White cable is UART_RX. Red and Black cables are 5V and GND, respectively. Then plug the USB-UART adapter to the user's computer.

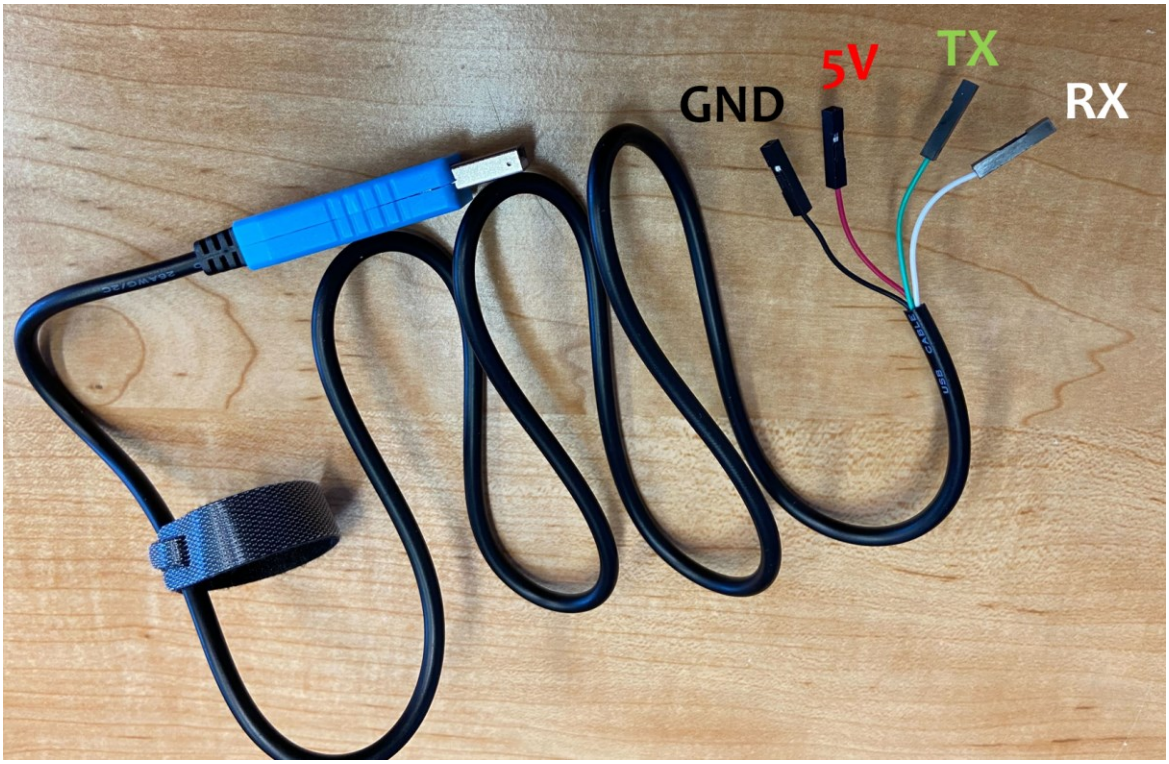


Fig. 5. UART's pins on USB-UART adapter. UART-TX (Green), UART-RX (White), 5V power supply (Red), and Ground (Black)

(ii) Based on the pin assignment table in Fig. 2, connect the BlueIO832-Mini [D1-D4] pins to the target device UART's pins, as shown in Fig. 5.

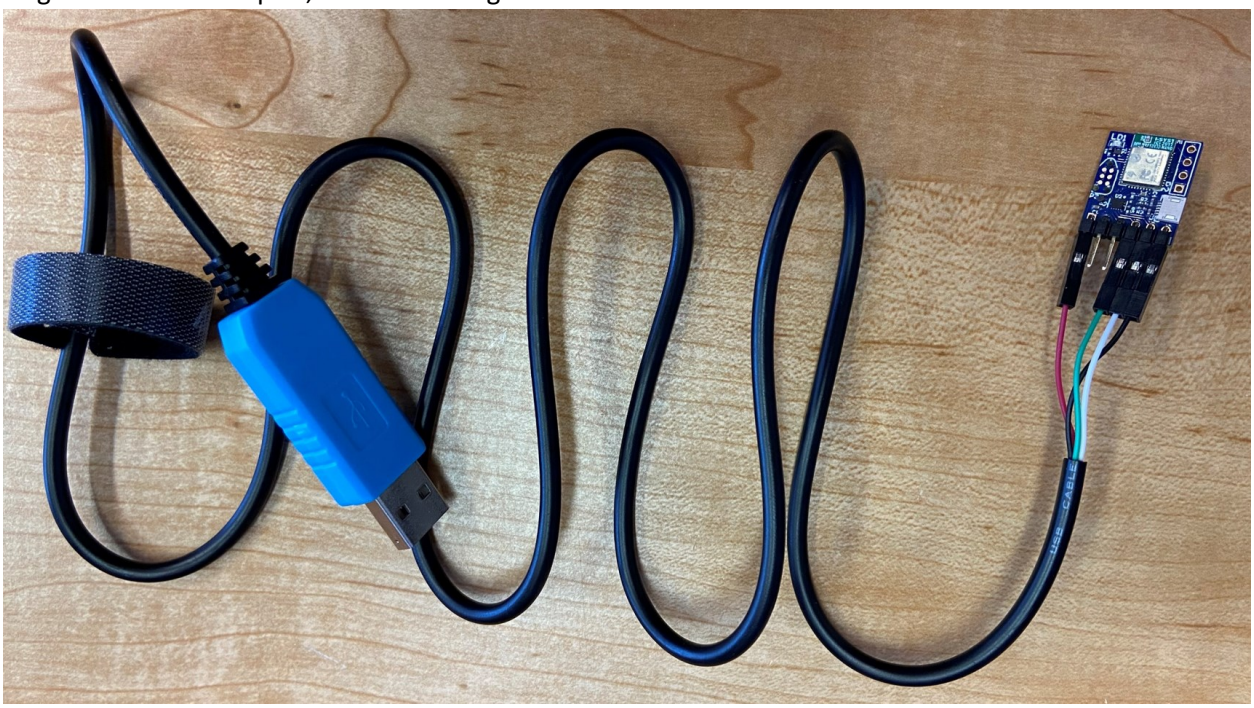


Fig. 6. Connect BlueIO832-Mini with a USB-UART adapter. The 5V and GND cables can be used for powering BlueIO832-Mini thanks to its internal level shifter.

(iii) Identify the parameters of the target device's UART interface: baud rate, flow control, and bit parity[3]. In this demo, the baud rate is 115200, no flow control, and no bit parity, 8-bit data frame.

(iv) Connect the USB-UART adapter to a computer. Install and open CoolTerm serial port app. In the CoolTerm Options menu → Serial Port Options, select the COM port number assigned for the USB-UART adapter, apply the UART parameters in step (iii) to Serial Port Options, and then click OK (Fig. 6).

Note 3: *The data bits are always 8.*

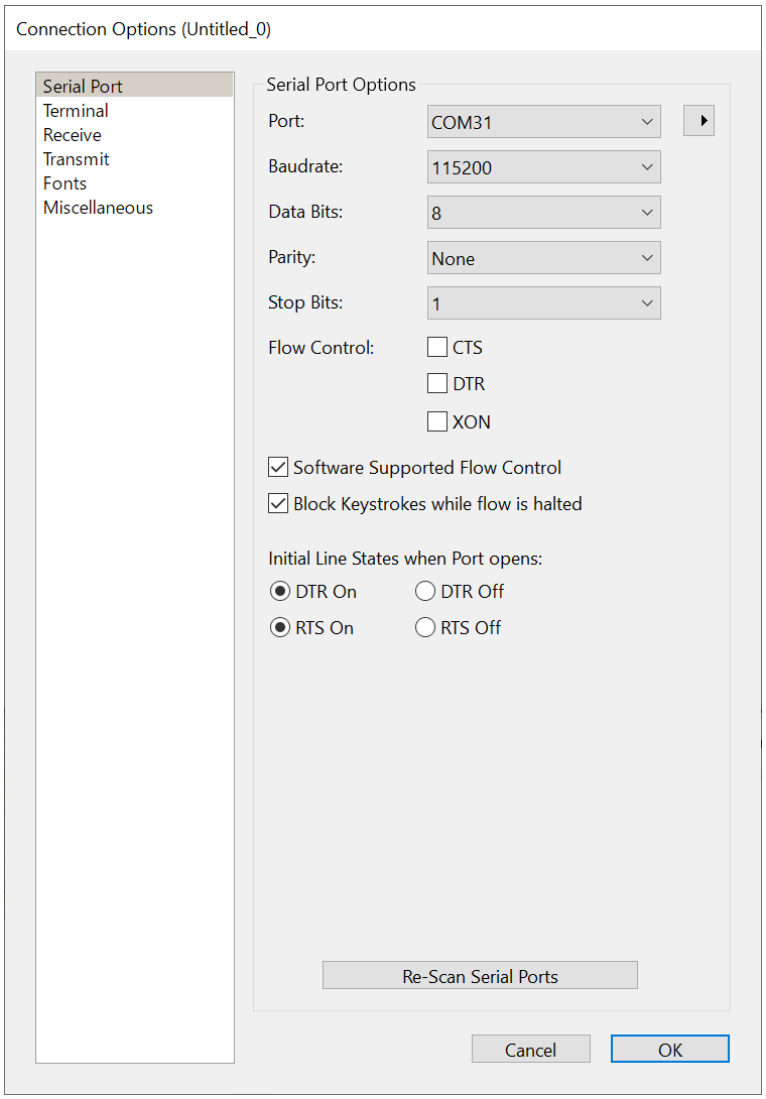


Fig. 7. Setting UART's parameters in CoolTerm.

2. Pair BlueIO832-Mini with the BlueIOTerm on mobile device

(i) Install the BlueIOTerm on the user's mobile device. The app can be found on Apple® AppStore and Google® Play app store.

3. Configure UART's setting on BlueIOTerm

(i) Turn on the Bluetooth® feature in the user's mobile device.

(ii) Open the BlueIOTerm mobile app.

(iii) Tap “SCAN” button to search for any BlueIO832-Mini existing arround. If the app found a BlueIO832-Mini, it displays “BlueIO832-Mini” onto the Select Device section (Fig. 7).

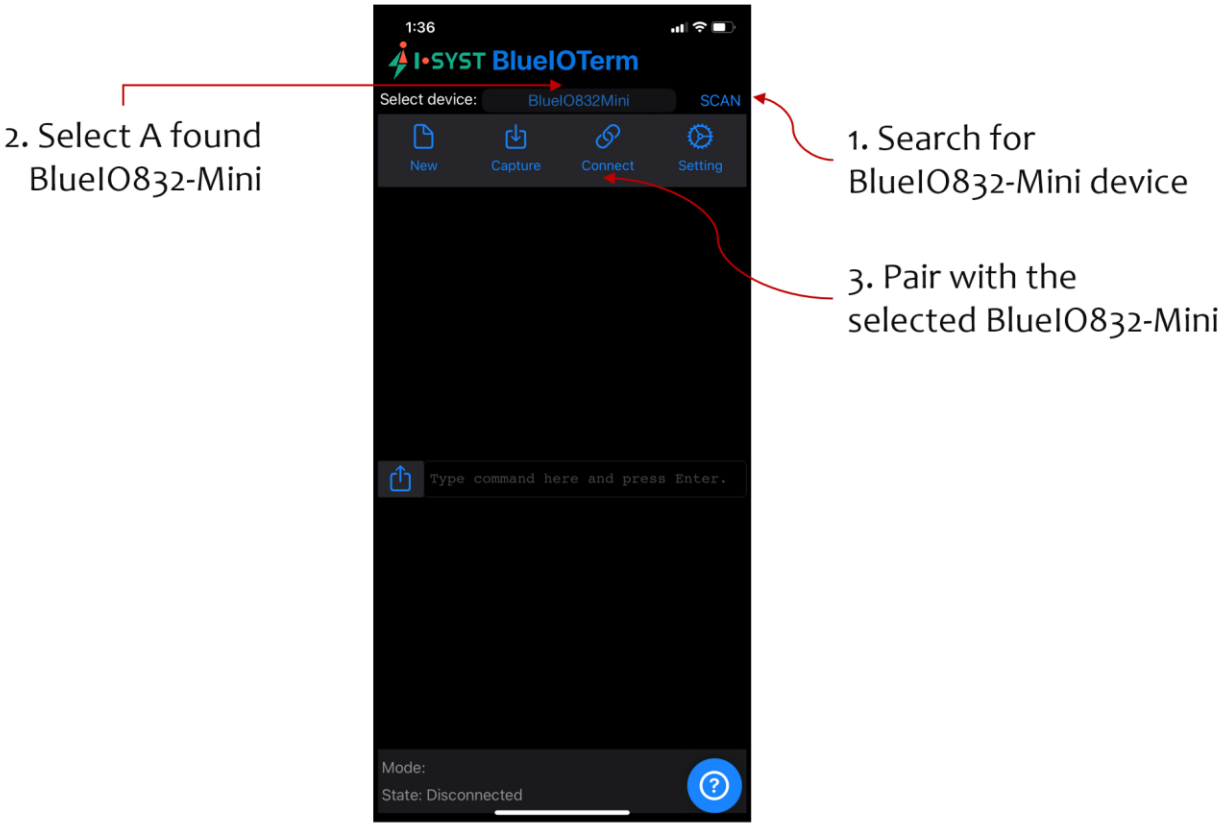


Fig. 8. Search and pair a BlueIO832-Mini with BlueIOTerm.

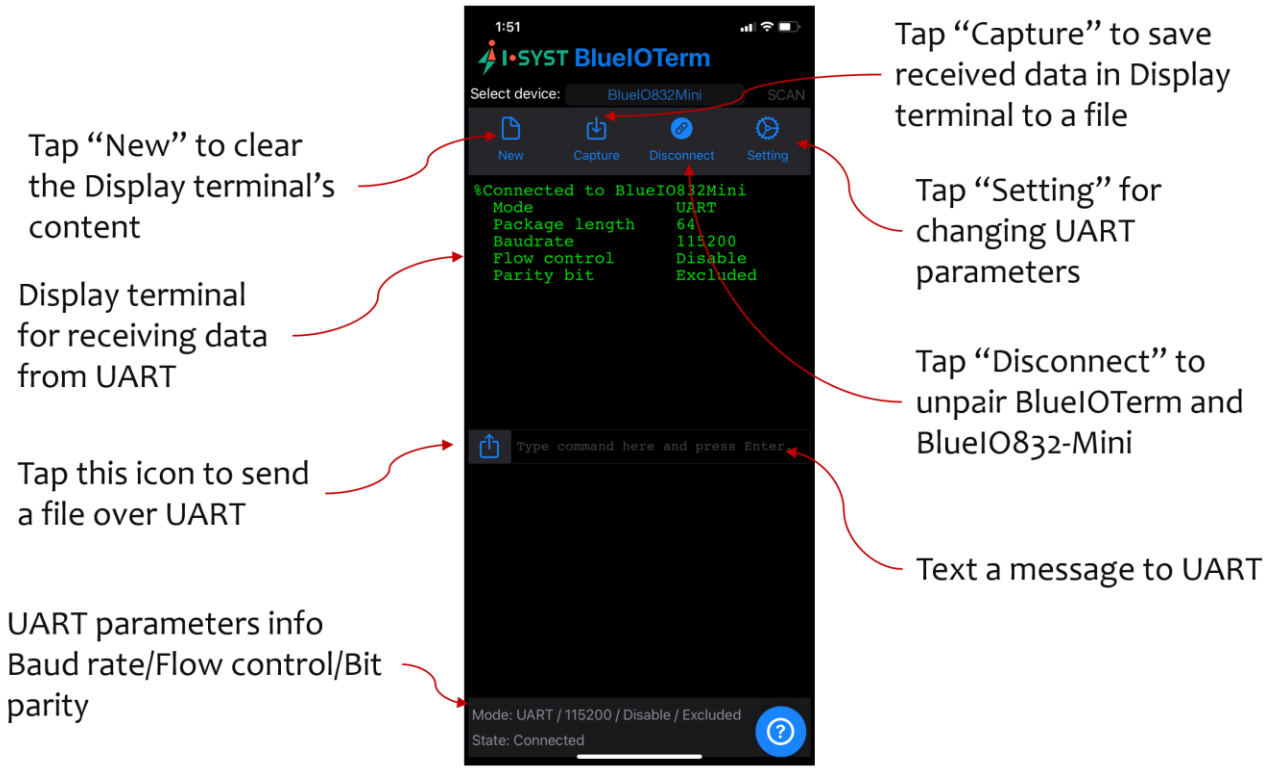


Fig. 9. Buttons and display sections of BlueIOTerm.

(iv) Tap "Connect" to pair BlueIO832-Mini with the app. The display terminal on the app shows the current UART parameters used by BlueIO832-Mini (Figs. 8 and 9). Now, BlueIOTerm is ready for the user to send messages to and/or receiving messages from the UART interface connect with BlueIO832-Mini (Fig. 10).

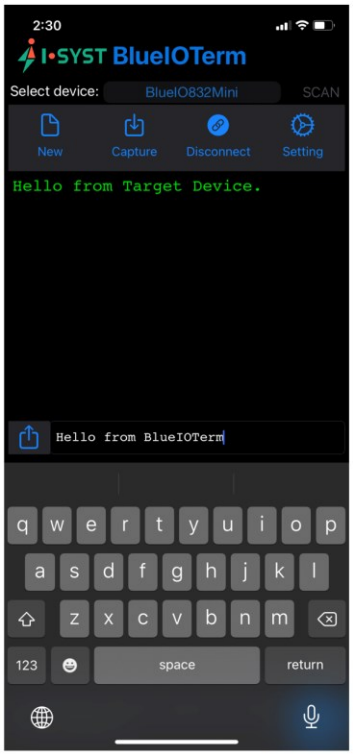


Fig. 10. Send and receive message in BlueIOTerm.

(v) To change the UART parameters, tap "Setting" to go to the UART configuration setting menu. The UART parameters shown in the menu are the current settings (Fig. 11).

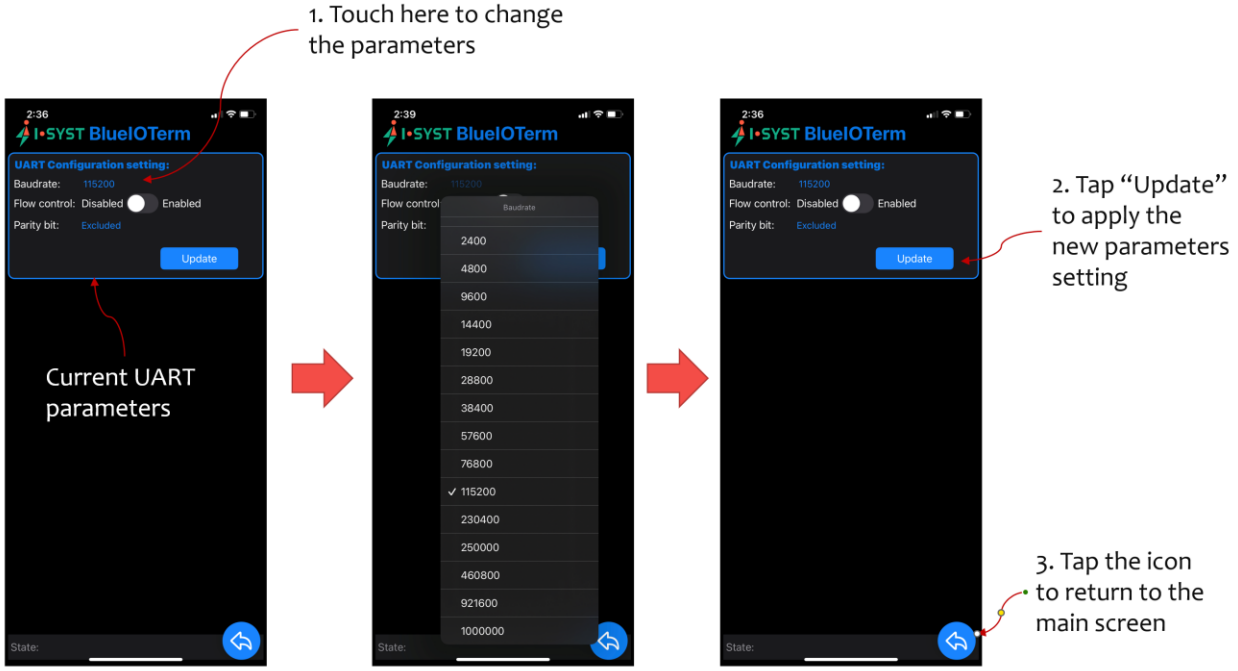


Fig. 11. Change UART parameters in BlueIOTerm.

IV. User-Own Firmware Development on BlueIO832-Mini

BlueIO832-Mini can be used as an **IoT embedded development kit** for developing the user's own firmware. We recommend the user to use our open-source library **IOsonata** for quickly developing the firmware. Here are references for the IOsonata SDK and the guides on firmware development with IOsonata:

- IOsonata is available on this Github link.
- The steps of developing firmware with IOsonata SDK are available on this blogpost.
- For debugging the firmware built upon IOsonata in Eclipse IDE, please refer to this blogpost.

References

[1] BlueIO832-Mini Product Page:

https://www.i-syst.com/products/blueIO832

[2] BlueIO832-Mini User Guide:

https://www.i-syst.com/sites/default/files/2022-08/BlueIO832Mini_UserGuide.pdf

[3] BlueIOTerm on Apple® AppStore

https://apps.apple.com/app/blueioterm/id1618808817?platform=iphone

[4] BlueIOTerm on Google® Play

https://play.google.com/store/apps/details?id=com.i_syst.blueioterm

[3] IOsonata Github

https://github.com/IOsonata/IOsonata

[4] Developing firmware for Nordic® nRF52xxx SoC with IOsonata

https://www.i-syst.com/article/eclipse-ide-firmware-development-iosonata

[5] Debugging firmware built upon IOsonata in Eclipse® IDE

https://www.i-syst.com/article/firmware-debugging-eclipse