



ChipletRing APP SDK manual IOS

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I、 Document Brief

1、 Document purpose

In order to facilitate the secondary development of communication between IOS APP and ring, the communication protocol is specially encapsulated to achieve simplicity and clarity, so that developers do not need to pay attention to the communication layer with ring, and focus on the development of business logic interaction level.

2、 Scope of application

Supported iOS version: iOS 13.0+

Supported language version: Swift 5.0+

Developer tools: xcode 15+

3、 Introduction Note

This is the Bluetooth communication SDK of smart ring, which mainly provides the API management class RingManager related to ring communication, and the related data storage management class RingDBManager, and also provides the realization of some complex algorithms, such as sleep-related algorithms.

Note: Since the sdk requires Bluetooth, only real machine debugging is supported, and be careful to add Bluetooth permission description in your project info

4、 Function Description

Function module	Instructions	Relevant documentation
Bluetooth basic module	<ul style="list-style-type: none"> ● Switch operation of Bluetooth ● Bluetooth search link operation ● Bluetooth data write listening operation 	

Communication protocol module	<ul style="list-style-type: none"> ● Time management ● Version number management ● Battery Management ● Heart rate measurement ● Blood oxygen measurement ● Temperature measurement ● Step management ● History management ● System Settings ● Log management 	
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II、 Quick use

1、 Use CocoaPods

Start by adding a new Spec source to your project's Podfile file by copying and pasting the following statement to the top of your project's Podfile:

```
1. source 'https://github.com/Z-y-hu/ChipletRing-SDK-iOS.git'
```

2、 Import SDK

Import this SDK in the pod:

```
1. pod 'Rings-SDK'
```

Then install:

```
1. pod install
```

Just introduce the SDK where it is used:

```
1. import RingsSDK
```

III、 API Function Description

1、 Device connection related

1.1 Search for Bluetooth

Interface description: search nearby bluetooth devices, after began to search through the callback to obtain a list of search to equipment, can also be through RingManager. Shared. The devices for current search attribute to the equipment

Interface declaration:

```
1. RingManager.shared.startScan { devices in
2. Print (" search to the equipment list = = = = = > \ (String (describing:
   devices)) ")
3. }
```

What to watch for: None

1.2 Stop searching

Interface description: stop search nearby bluetooth devices, to stop search not empty has searched the equipment list, is not empty RingManager. Shared. Devices

Interface statement:

```
1. RingManager.shared.stopScan()
```

Note: When invoking this interface, ensure that it is connected to the ring

1.3 Connect the specified Bluetooth

Interface description: Connect the specified device by the device uuid, uuid obtained from the device model DeviceInfo

Interface declaration:

```
1. RingManager.shared.startConnect(deviceUUID: "uuidString", resultBlock: { res in
2.     switch res {
3.     case .success(let deviceInfo):
4.     Print (" connected equipment = = = = = > \ (String (describing: deviceInfo
```



```
        peripheralName)) ")

5.         case .failure(let error):

6.     print(" Connection failed =====> \(error)")

7. }

8. })

9.
```

What to watch for: None

1.4 Disconnect Bluetooth

Interface description: Disconnect the current device

Interface declaration:

```
1. RingManager.shared.disconnect()
```

Note: When invoking this interface, ensure that it is connected to the ring

1.5 Currently connected to Bluetooth

Interface Description: Get the currently connected device

Interface declaration:

```
1. let currentDevice = RingManager.shared.currentDevice
```

Note: When invoking this interface, ensure that it is connected to the ring

1.6 Bluetooth connection status

Interface description: Get device connection status

Interface declaration:

```
1. let isDidConnect = RingManager.shared.isDidConnect
```

Note: None

1.7 Listen for connection status

Interface description: Device connection status change monitoring

Interface declaration:

```
1. RingManager.shared.connectStateChangeBlock = { isConnected in
2.   print(" Is it connected =====\(isConnected)")
3.
4. }
```

What to watch for: None

2、 Instruction function

2.1 Synchronizing time

Interface description:

Interface declaration:

```
1. RingManager.shared.syncTime(date: Date()) { res in
2.     switch res {
3.         case .success(let isSuccess):
4.             Print (" synchronization time results = = = = = \ (isSuccess) ")
5.         case .failure(let error):
6.             print(" Sync failed =====\ (error)")
7.     }
8. }
```

Note: When calling this interface, ensure that it is connected to the ring

2.2 Read time

Interface description:

Interface declaration:

```
1. RingManager.shared.readTime { res in
2.     switch res {
3.         case .success(let value):
4.             print(" Success =====>\(value) milliseconds ")
5.         case .failure(let error):
6.             print(" fail =====>\(error)")
7.     }
8. }
```

Note: When calling this interface, ensure that it is connected to the ring

2.3 Read the software version number

Interface description:

Interface declaration:

```
1. RingManager.shared.readAppVersion { res in
2.     switch res {
3.         case .success(let version):
4.             Print (" software version number = = = = > \ (version) ")
5.         case .failure(let failure):
6.             print(" fail =====>\(failure)")
7.     }
8. }
```

Note: When calling this interface, ensure that it is connected to the ring

2.4 Read the hardware version number

Interface description:

Interface declaration:

```
1. RingManager.shared.readHardWareVersion { res in
2.     switch res {
3.         case .success(let version):
4.             Print (" the hardware version number = = = = > \ (version) ")
5.         case .failure(let failure):
6.             print(" fail =====>\(failure)")
7.     }
8. }
```

Note: When calling this interface, ensure that it is connected to the ring

2.5 Read the battery level

Interface description: If the battery level returned is 101, it means that it is being charged

Interface statement:

```
1. RingManager.shared.readBattery { res in
2.     switch res {
3.         case .success(let value):
4.             print(" Electricity =====>\(value)")
5.         case .failure(let failure):
6.             print(" fail =====>\(failure)")
7.     }
8. }
```

Note: When calling this interface, ensure that it is connected to the ring

2.6 Read the battery charging status

Interface description: Read the battery charging status, return the result as ChargeStatus enumeration type, the value is:

- full: ChargeStatus
- charging: Being charged
- normal: Normal uncharged state

Interface declaration:

```
1. RingManager.shared.readChargeStatus { res in
2.     switch res {
3.         case .success(let state):
4.             print(" status =====>\(state)")
5.         case .failure(let error):
6.             print(" fail =====>\(error)")
7.     }
8. }
```

Note: When calling this interface, ensure that it is connected to the ring

2.7 Measure the heart rate in real time

Interface description: Output real-time heart rate measurement value, BPM. Only when isOpenWave is set to true, the waveform data will be read, and it will be called back through the tableBlock closure.

Interface declaration:

```
1. RingManager.shared.readHeartRate(progressBlock: { progress in
2.     print(" progress =====>\(progress)")
3. }, isOpenWave: true) { seq, num, datas in
4.     print(" serial number =====>\(seq)")
5.     print(" Number of data =====>\(num)")
6.     print(" Waveform data =====>\(datas)")
```

```

7.         } resultBlock: { res in
8.             switch res {
9.                 case .success(let success):
10. print(" success =====>\(success)")
11.                 case .failure(let failure):
12. print(" fail =====>\(failure)")
13. }
14. }

```

Note: When calling this interface, ensure that it is connected to the ring

2.8 Heart rate variability

Interface description: Output heart rate variability in milliseconds (ms).The waveform data is read only if isOpenWave is set to true, and it is called back through the tableBlock closure.

Interface declaration:

```

1. RingManager.shared.readHRV(progressBlock: { progress in
2.     BDLLogger. Info (" progress = = = = > \ (progress) ")
3.         }, isOpenWave: true) { seq, num, datas in
4.     BDLLogger.info(" serial number =====>\(seq)")
5.     BDLLogger.info(" Number of data =====>\(num)")
6.     BDLLogger. Info (" waveform data = = = = > \ (datas) ")
7.         } resultBlock: { res in
8.             switch res {
9.                 case .success(let success):
10. BDLLogger. Info (" success = = = = > \ (success) ")

```

```

11.         case .failure(let failure):
12. BDLogger. Info (" = = = = > failure \ (failure) ")
13. }
14. }

```

Note: When calling this interface, ensure that it is connected to the ring

2.9 Measure blood oxygen value in real time

Interface description: Output real-time blood oxygen value. Only when isOpenWave is set to true, the waveform data is read, and it is called back through the tableBlock closure.

Interface declaration:

```

1. RingManager.shared.readO2(progressBlock: { progress in
2. BDLogger. Info (" progress = = = = > \ (progress) ")
3.         }, isOpenWave: true) { seq, num, datas in
4. BDLogger.info(" serial number =====>\(seq)")
5. BDLogger.info(" Number of data =====>\(num)")
6. BDLogger. Info (" waveform data = = = = > \ (datas) ")
7.         } resultBlock: { res in
8.         switch res {
9.         case .success(let success):
10. BDLogger. Info (" success = = = = > \ (success) ")
11.         case .failure(let failure):
12. BDLogger. Info (" = = = = > failure \ (failure) ")
13. }
14. }

```

Note: When calling this interface, ensure that it is connected to the ring

2.10 Read the temperature

Interface description: Read the current temperature, return the result in Celsius (° C)

Interface declaration:

```
1. RingManager.shared.readTemperature { res in
2.     switch res {
3.         case .success(let value):
4.             BDLogger. Info (" = = = = > \ temperature (value) ")
5.         case .failure(let error):
6.             BDLogger. Info (" = = = = > failure \ (error) ")
7.     }
8. }
```

Note: When calling this interface, ensure that it is connected to the ring

2.11 Read the number of real-time steps on the day

Interface description:

Interface declaration:

```
1. RingManager.shared.readSteps { res in
2.     switch res {
3.         case .success(let value):
4.             print(" Number of steps =====>\(value) steps ")
5.         case .failure(let error):
6.             print(" fail =====>\(error)")
7.     }
```



```
8. }
```

Note: When calling this interface, ensure that it is connected to the ring

2.12 Clear the number of live steps

Interface description:

Interface declaration:

```
1. RingManager.shared.clearSteps { res in
2.     switch res {
3.         case .success(let isSuccess):
4.             print(" Result =====>\(isSuccess)")
5.         case .failure(let error):
6.             print(" fail =====>\(error)")
7.     }
8. }
```

Note: When calling this interface, ensure that it is connected to the ring

2.13 Read local data

Interface description: Read the local historical data, and the internal will be each data stored in the database. For how to get the data from the database, see the RingDBManager section of the database management class

Interface declaration:

```
1. RingManager.shared.readDatas { progress, dataModel in
2.     Print (" progress = = = = > \ (progress) = = \ [dataModel) ")
3.     } resultBlock: { res in
```

```
4.      switch res {  
5.          case .success(let state):  
6.      print(" Result =====>\(state)")  
7.          case .failure(let error):  
8.      print(" fail =====>\(error)")  
9.      }  
10. }
```

Note: When calling this interface, ensure that it is connected to the ring

This API obtains the device history data. Each history information obtained is called back by the progressBlock closure. After obtaining all the results, the final result is called back by the resultBlock.dataModel is the device data model, and the related properties are as follows:

```
1. public final class RingDataModel: NSObject,TableCodable {  
2. // Total number  
3.     public var total:UInt32 = 0  
4. // Serial number, starting from 1  
5.     public var serialNum:UInt32 = 0  
6. // Timestamp, seconds  
7.     public var timestamp:UInt32 = 0  
8. // Number of accumulated steps by the end of the current day  
9.     public var stepsOfTheDay:UInt16 = 0  
10. // Heart rate,0 is invalid  
11.     public var rate = 0  
12. // Blood oxygen,0 does not work  
13.     public var O2 = 0
```

```
14. // Heart rate variability,0 is not valid
15.   public var hrv = 0
16. // Mental stress index,0 is not valid
17.   public var mentalStress = 0
18. // Temperature, signed
19.   public var temp:Float = 0
20. // Motion intensity 0: stationary 0x65: motion
21.   public var isRunning = false
22. // Sleep type 0: ineffective 1: awake 2: light sleep 3: deep sleep 4. Eye
    movement Period
23.   public var sleepType = 0
24. // RR Number of periods
25.   public var RRNums = 0
26. // RR array
27.   public var rrs:[Int] = []
28. }
```

Returned value: state is of the ReadDataResult enumeration type with the values:

```
1. public enum ReadDataResult {
2. case empty // No data
3. case complete // Finished
4. }
```

2.14 Delete data

Interface Description: Delete all local data history

Interface statement:

```
1. RingManager.shared.clearRingData { res in
2.     switch res {
3.         case .success(let isSuccess):
4.             print(" Result =====>\(isSuccess)")
5.         case .failure(let failure):
6.             print(" fail =====>\(failure)")
7.     }
8. }
```

Note: When calling this interface, ensure that it is connected to the ring

2.15 Set the collection period

Interface description: collection cycle setting, collection cycle setting unit is seconds (s)

Interface declaration:

```
1. RingManager.shared.setFrequency(time: time) { res in
2.     switch res {
3.         case .success(let isSuccess):
4.             Print (" results = = = = > \ (isSuccess) ")
5.         case .failure(let failure):
6.             Print (" = = = = > failure \ (failure) ")
7.     }
8. }
```

Note: When calling this interface, ensure that it is connected to the ring

2.16 Read acquisition cycle

Interface description: acquisition cycle read, read the acquisition cycle of seconds (s)

Interface declaration:

```
1. RingManager.shared.readFrequency { res in
2.     switch res {
3.     case .success(let value):
4.         print(" success =====>\(value) seconds ")
5.     case .failure(let error):
6.         print(" fail =====>\(error)")
7.     }
8. }
```

Note: When calling this interface, ensure that it is connected to the ring

2.17 factory data reset

Interface description:

Interface declaration:

```
1. RingManager.shared.reset { res in
2.     switch res {
3.     case .success(let isSuccess):
4.         print(" success =====>\(isSuccess)")
5.     case .failure(let error):
6.         print(" fail =====>\(error)")
7.     }
```

```
8. }
```

Note: When calling this interface, ensure that it is connected to the ring

3、 Firmware Upgrade (OTA)

Interface description: For firmware upgrade, fileUrl indicates the local path where the firmware file resides. The upgrade progress and result are called back through handle

Interface declaration:

```
1.  if let path = Bundle.main.path(forResource: "otafilename", ofType: nil) {  
2.      let url = URL(fileURLWithPath: path)  
3.      RingManager.shared.startOTA(url) { res in  
4.          switch res {  
5.              case .start:  
6.                  print(" Start upgrading =====>")  
7.                  case .progress(let value):  
8.                      print(" Upgrade progress =====>\(value)")  
9.                  case .success:  
10.                     print(" Upgrade successful =====>")  
11.                     case .fail(let errorString):  
12.                         print(" Upgrade failed =====>\(errorString)")  
13.                 }  
14.             }  
15.         }
```

Note: When calling this interface, ensure that it is connected to the ring

4、 Database RingDBManager

Use func readDatas(progressBlock: @escaping (Double, RingDataModel)->Void, resultBlock: escaping (Result<ReadDataResult, ReadError>)->Void) gets the local history from the device and saves it to the local database, which is accessed using the RingDBManager class. A singleton is provided internally to manipulate the relevant data. The singleton can be obtained by RingDBManager.shared. The following is the related API description.

4.1 Get the specified time data

Interface description: Get all the historical data from the specified time to date from the database with a 10-bit timestamp parameter

Interface declaration:

```
1. public func getObjects(from timestamp:TimeInterval) -> [RingDataModel]
```

Note: When invoking this interface, ensure that it is connected to the ring

4.2 Get the data of a certain day

Interface description: Get the historical data of a certain day from the database (get the data from 00:00 to 24:00 on the date)

Interface declaration:

```
1. public func getObjects(of date:Date) -> [RingDataModel]
```

Note: When invoking this interface, ensure that it is connected to the ring

4.3 Get the last piece of data

Interface Description: Obtains the latest historical data from the database at the current time

Interface declaration:

```
1. public func getLatestObject() -> RingDataModel?
```

Note: When invoking this interface, ensure that it is connected to the ring

4.4 Get the sleep data of a certain day

Interface description: Get the sleep data of a certain day from the database (get the data from 18:00 on the previous day to 18:00 on the date). The data obtained by this part of the interface is mainly used for the

calculation of sleep

Interface declaration:

```
1. public func getSleepObjects(of date:Date) -> [RingDataModel]
```

Note: When invoking this interface, ensure that it is connected to the ring

4.5 Delete all data

Interface Description: Delete all historical data from the local database

Interface statement:

```
1. public func deleteAll() -> Bool
```

Note: When invoking this interface, ensure that it is connected to the ring

4.6 Delete the data from the specified time to the present

Interface description: Delete all historical data from the specified time up to the present time with a 10-bit timestamp parameter

Interface declaration:

```
1. public func deleteAllBeforeTimestamp(timestamp:TimeInterval) -> Bool
```

Note: Before invoking this interface, ensure that it is connected to the ring

5、 Logical algorithm

This part of the code is in the RingManager class, use ringmanager.shared to get the singleton, and then call the relevant API

5.1 Calculate walking distance

Interface description: Walking distance calculation, steps parameter is the number of steps, stepSize parameter is the step length, the unit is centimeter (cm), the return result is the distance, the unit is meters (m)

Interface declaration:

```
1. func calculateDistance(steps:Int,stepSize:Int) -> Float
```

Note: When calling this interface, ensure that it is connected to the ring

5.2 Sleep time calculation

Interface description: Sleep time calculation, obtain the specified date of sleep data and sporadic sleep data. The return value is a tuple, the first element of the tuple (\$0.0) is the sleep data collection, the second element (\$0.1) is a two-dimensional array, is a collection of sporadic sleep segments. The time of the first data point in the \$0.0 array is the time of falling asleep, the time of the last data point is the time of waking up, and the time of each data point in the middle is the sleep time. In the same way, the sporadic sleep duration can be calculated by using the data in the \$0.1 array.

Interface declaration:

```
1. func caculateSleepData(targetDate: Date) -> ([RingDataModel], [[RingDataModel]])
```

Note: When invoking this interface, ensure that it is connected to the ring

5.3 Get sleep duration

Interface description: Get the sleep duration, pass the sleep time data point set, you can get the sleep duration, return the sleep duration unit is minute (min)

Interface declaration:

```
1. func calculateSleepTimes(sleepDatas:[RingDataModel]) -> Int
```

Note: When invoking this interface, ensure that it is connected to the ring

6、 Log configuration

Interface description: Set the log saving path, the default is saved in the sandbox Document. You can modify the default save path through the following API

Interface declaration:

```
1. func configLogPath(directoryPath: String = defaultLogDirectoryPath)
```

Note: When invoking this interface, ensure that it is connected to the ring

IV、 Others

1、 Problems that may be encountered

1.1 Errors using the SDK

Upgrade your development tools to the appropriate range

nullSupported iOS version: iOS 13.0+

nullSupported language versions: Swift 5.0+

nullDeveloper tool: xcode 15+

1.2 When reading the software version, it returns two more Spaces

The version number is 10 bytes, with Spaces filled in.

Supplement: Firmware versions are usually numbers with the letter S at the end

1.3 Call interface, return timeout

Send a command, after 3 seconds, the ring does not respond, will return a timeout

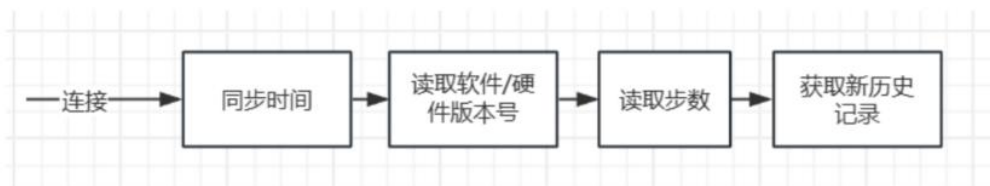
The timeout problem should be analyzed in detail

1.4 How can the sleep function of the ring be measured

Just wear the ring to sleep.If the APP reads the readDatas interface during sleep, it can also get the current sleep data.

1.5 The sleep data read contains the previous days' data

在绑定后，每次打开 APP 自动以最快的速度连接戒指。连接流程如下：



Probably because the time stamps are not synchronized

1.6 Cloud OTA Updates

This SDK provides path update mode. OTA firmware package is placed in the cloud. After downloading, the path of firmware package can be given to SDK

Note: OTA update version will clear the data

1.7 The database has no data or the database only has n data

Problem: I called readData, but I can't get the data in db

Specific: RingManager. Shared. ReadHeartRate callback, after readDatas, getObjects database data

Solution: Delete the APP that accesses the SDK and reinstall it (the reason is that the data read is judged to be not the first read)

2、 Supplementary information

2.1 Sleep data

Provide sleep use case tests (contact us, send as zip pack) including wake up, baseline, fall asleep, wake up during sleep, and combination tests with.DAT files under each item. The data is analyzed as follows

2.1.1 Follow the protocol

1 Change not 1 is to fall asleep, and change 1 again is to be awake

2.1.2 Data parsing

Chronotypes:

0: Invalid

1: Sober

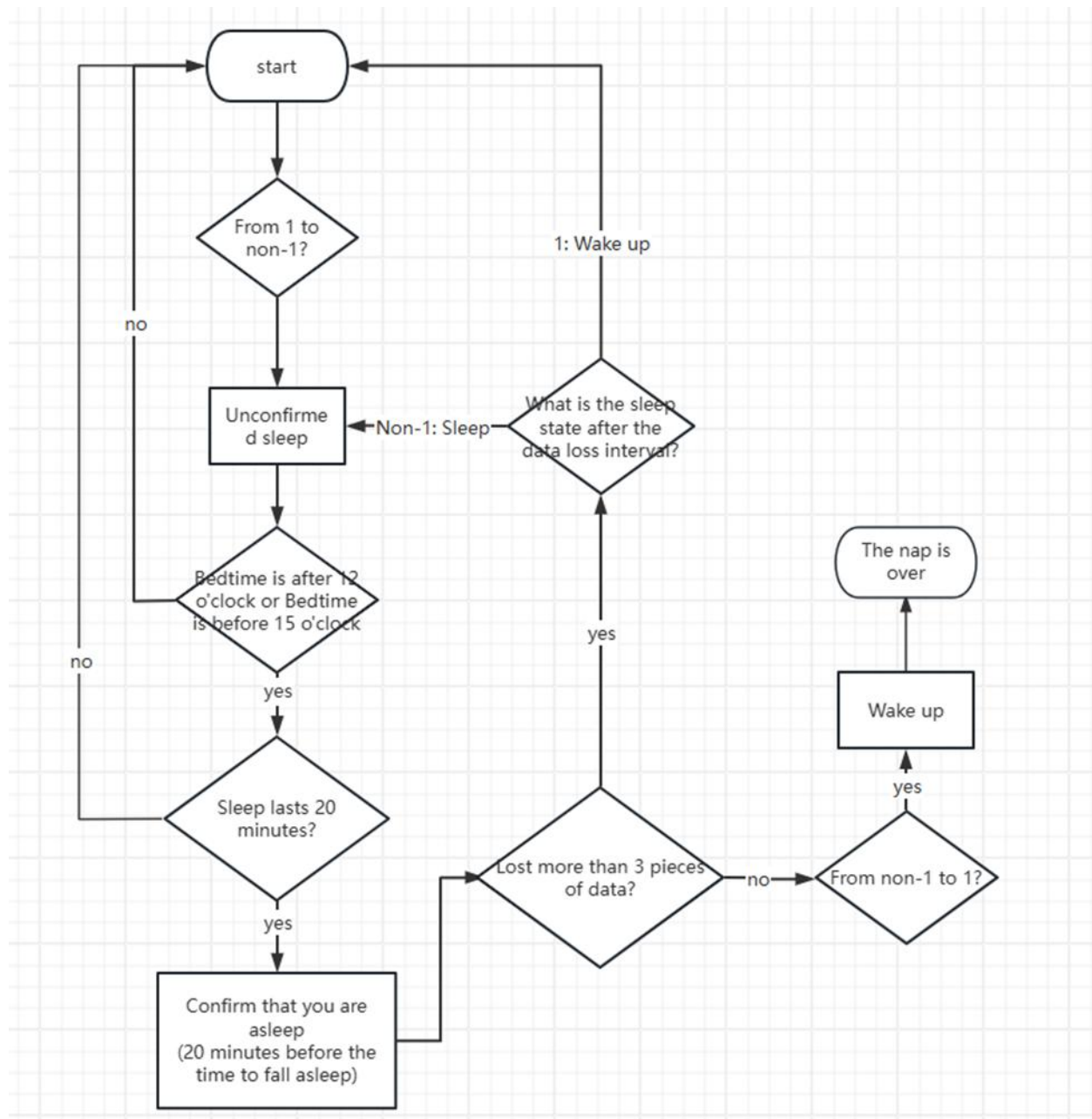
2: Light sleep

3: Deep sleep

4: Eye movement period

[180: 12]	2023.10.18_21.00.00	step:	0	hr:	70	spo2:	0	hrv:	0	sprit:	0	temp:	0	sport:	0	sleep:1	sleep_time:	0	rr_num:	0
[180: 13]	2023.10.18_21.05.00	step:	0	hr:	70	spo2:	0	hrv:	0	sprit:	0	temp:	0	sport:	0	sleep:2	sleep_time:	0	rr_num:	0
[180: 14]	2023.10.18_21.10.00	step:	0	hr:	70	spo2:	0	hrv:	0	sprit:	0	temp:	0	sport:	0	sleep:2	sleep_time:	0	rr_num:	0
[180: 15]	2023.10.18_21.15.00	step:	0	hr:	70	spo2:	0	hrv:	0	sprit:	0	temp:	0	sport:	0	sleep:2	sleep_time:	0	rr_num:	0
[180: 16]	2023.10.18_21.20.00	step:	0	hr:	70	spo2:	0	hrv:	0	sprit:	0	temp:	0	sport:	0	sleep:2	sleep_time:	0	rr_num:	0

2.3 Nap logic diagram



3、 Q&A

3.1 Ring

Q: Will manual measurement data be saved to the database? Heart rate, blood, oxygen?

A: yes

Q: What is the default collection period?

A: 1200s/20min

Q: How is the ring data generated and what is the generated data structure?

A: The ring will be automatically tested every certain time (default is 5 minutes), including the content of the test, including heart rate, blood oxygen, heart rate variability, sleep status, etc., so as to generate a sample data point, a data point corresponds to a RingDataModel model object, the sample data will be stored in the ring, over time, More and more data points will be stored in the ring, but only the most recent 7 days of data will be saved.

Q: Where is the log when testing with ChipletRing

A: Find my → Log on the APP page

3.2 SDK

Q: How do I use the SDK to read data from the ring?

A: After connecting the ring, the data in the ring will not be actively reported, you need to call the corresponding SDK method to obtain, you can use the following methods to read the data in the ring

```
1. func readDatas(progressBlock: @escaping (Double, RingDataModel) -> Void, resultBlock: @escaping (Result<ReadDataResult, ReadError>) -> Void)
```

Note: When calling this method for the first time, all the historical data points stored in the ring will be read. After successfully obtaining all the historical data, calling this method will only read the new data points that have not been read in the ring. If no new data is generated in the ring or the data in the ring has been read, the data obtained by calling this method will be empty. Internally, this method stores all the data points it gets into a local database built into the SDK.

How does the SDK know if the data has been read?

In the preferences, there is a local save record that has not been read

Q: How do I get data for a given date from the SDK's built-in database?

A: After we read the data from the ring, the RingDBManager management class can be used to get the relevant data, and getObjects(of date: Date) can be used to get the specified date data. Such as getting today's data

```
1. // Get today's data from the database
2. let date = Date()
3. let datasOfToday = RingDBManager.shared.getObjects(of: date)
```

Q: The general process of using the SDK to develop apps and obtain data

A: After connecting the device, use the following method to read the data in the ring

```
1. func readDatas(progressBlock: @escaping (Double, RingDataModel) -> Void, resultBlock:
```

```
@escaping (Result<ReadDataResult, ReadError>)->Void)
```

After obtaining the data successfully, call the following method to obtain the data of the specified date from the database to get the latest data.

```
1. func caculateSleepData(targetDate: Date) -> ([RingDataModel], [[RingDataModel]])
```

The return value is a tuple, and the first element of the tuple (\$0.0) is the sleep data set, where the first data point is the sleep fall point data, and the last data point is the sleep wake point data. The second element of the tuple (\$0.1) is a two-dimensional array that is a collection of sporadic sleep segments. Each of these arrays has the same meaning as described above.

Q: After obtaining the sleep data, how to obtain the sleep time, wake time and sleep time? How to calculate the wake time, light sleep time, deep sleep time and eye movement time?

A: for example

```
1. // Get sleep data from last night
2. let date = Date()
3. let allDatasOfSleeps = RingManager.shared.caculateSleepData(targetDate: date)
4. let datas = allDatasOfSleeps.0
5. print("sleeping =====>\(String(describing: datas.first?.timestamp))")
6. print("waking =====>\(String(describing: datas.last?.timestamp))")
7.
8. let sleepTimes = RingManager.shared.calculateSleepTimes(sleepDatas: datas)
9. print("睡眠时间 =====>\(sleepTimes)分钟")
10.
11.
12. var lastModel:RingDataModel?
13. // Wakefulness time, in seconds
14. var wakeTimes:UInt32 = 0
15. // Light sleep duration, in seconds
```

```
16.     var lightSleepTimes:UInt32 = 0
17.     // Length of deep sleep, in seconds
18.     var deepSleepTimes:UInt32 = 0
19.     // Eye movement duration, in seconds
20.     var eyesTimes:UInt32 = 0
21.     datas.forEach { model in
22.         if let tempLastModel = lastModel {
23.             switch model.sleepType {
24.                 case 1:// Wakefulness
25.                     wakeTimes += model.timestamp – tempLastModel.timestamp
26.                 case 2:// Light sleep
27.                     lightSleepTimes += model.timestamp – tempLastModel.timestamp
28.                 case 3:// deep sleep
29.                     deepSleepTimes += model.timestamp – tempLastModel.timestamp
30.                 case 4:// Eye movement
31.                     eyesTimes += model.timestamp – tempLastModel.timestamp
32.                 default :
33.                     break
34.             }
35.             lastModel = model
36.         }else{
37.             lastModel = model
```



```
38.     }  
39.     }  
40.  
41.     print("wakeTimes =====>\(wakeTimes)")  
42.     print("lightSleepTimes =====>\(lightSleepTimes)")  
43.     print("deepSleepTimes =====>\(deepSleepTimes)")  
44.     print("eyesTimes =====>\(eyesTimes)")
```

3.3 Troubleshooting

3.3.1 Failed to Search for Nearby Bluetooth Devices Using the SDK

1. iOS demo run `RingManager.shared.startScan`Method keeps reporting errors `Rings-SDK_Example[44209:4371892] [CoreBluetooth] API MISUSE: <CBCentralManager: 0x2816cb680> can only accept this command while in the powered on state`

Situation: in the process of using the SDK, call `RingManager.Shared` the `startScan` program for the next step, not stuck here, in the debugging shows that the above message

Troubleshooting method: After testing with `ChipletRingAPP`, it is found that Bluetooth can be found, but the connection cannot be connected: rssi: -74, the connection fails

Find the reason: the ring is out of power/the charge is too low, the problem is solved after charging.

Note: `RingManager.Shared`. After `startScan` call don't care about the message, a search will be automatically connected to the equipment.

3.3.2 Failed to Decompress the Compressed Package

Here provide the git web site: <https://github.com/Z-y-hu/ChipletRing-SDK-iOS>. downloadable