

BD-801 User Manual

1. Introduction

BD-801 can be used as a perfect development platform for fingerprint application. Besides the fingerprint recognition main feature, its expandable connector allow user to add external components or application board. This will ease the development and so shorten the time to market. Those ready to add components include mono LCD, IRDA, buzzer, clock chip, contactless RFID card and smart card. For the most important point, our development boards support on the field software upgrade through the use of the debug monitor programmed inside. This will allow us to customize made the firmware fulfilling the future need of any customer.

2. Main Features

- Fingerprint registration and verification.
- Up to 468 fingerprint templates can be stored inside the on board flash.
- 122 x 32 dot matrix LCD with background light support displaying English and Chinese. Other languages can also be displayed by upgrading the font database.
- 2 RS232 ports and 1 RS485 port for connecting to PC or other peripherals.
- 7 expandable connectors for connecting to external circuits.
- 4K bytes EEPROM for saving any general data.
- 16 keys pinpad for user input.
- Real time clock display.
- Power can be retrieved from the PS/2 port.
- Built in demo application firmware.
- Built in debug monitor for manual operation of the board and software upgrade.
- Built in development mode for customers that wish to treat our board as a standalone fingerprint recognition device.

3. Installation

3-1. Retrieve power from PC

If you want to power up the development board using the PS/2 port, please use the provided cable to make the connection between the development board and the PC. Remember to switch off the PC before doing the following connection steps. At the back of the PC, please unplug your mouse or keyboard from the PS/2 port. Then you can plug in the cable with the 6-pin mini DIN male end. The unplugged mouse or keyboard should connect to the other 6-pin mini DIN female end. Please also plug in the DB9 female connector to either COM1 or COM2 if you wish to use debug monitor, a utility firmware that allows user to operate the board manually. The other end of the cable should be connected to the fingerprint module board. Pay attention to the missing pin on top of the module board so that you will not connect the cable in the wrong direction. You can now switch on your PC after all connections are done completely. Press the reset button on the development board and remove the jumper in S2. You should see the “Heng Yu Tech” caption showing for 1 to 2 seconds. If you are sure that the development board has got the power supply but you still cannot see the caption, you might need to adjust the LCD contrast by turning the variable resistor clockwise. The variable resistor is located below the LCD.

3-2. External power supply

If you want to power up the development board from an external power supply, you don't need the provided cable any more. Remember to switch off the power supply before doing the following connection steps. You can plug in the power supply through J0. Pay attention to polarity of J0 when you apply the power. The inner pin is positive and outer metal plate is ground. Reverse the polarity might damage the development board. Don't try to connect the board to the PS/2 port while external power supply is connected. This might again damage the board. You can now switch on the power supply after all connections are done completely. Press the reset button on the development board and remove the jumper in S2. You should see the “Heng Yu Tech” caption showing for 1 to 2 seconds. If you are sure that the development board has got the power supply but you still cannot see the caption, you might need to adjust the LCD contrast by turning the variable resistor clockwise. The variable resistor is located below the LCD.

4. Using the demo application program

4-1. Register the administrator

The development board is shipped with no fingerprint template stored inside. So, you need to register at least one administrator in order to use the demo application program. After the “Heng Yu Tech” title was displayed, you are asked to register an administrator. Please input a staff id for this administrator and then press enter. (Staff ID ranges from 0000 to 9998) The program will prompt you to place your finger on top of the fingerprint sensor. Please follow the instruction to place and remove the finger twice. The first time is for enrollment and the second time is for verification. If you do it correctly, you should now in the administration menu. Otherwise, you need to repeat the registration process until it is done correctly. Press ‘0’ key to turn to the next page and press ‘6’ to exit the menu. Now, the firmware is ready for operation.

4-2. Basic operation

The application program is said to be in a standby mode when the LCD is off. At this state, it is ready to accept the user input. You can input the staff ID and then press enter. If this ID is existed, it will prompt you to put your finger on top of the fingerprint sensor. The verification result is shown after you remove the finger. 9999 is a special staff ID dedicated for all administrators. Any administrator can use this ID to login the system. Rather than just show you the verification result, it will bring you into the administration menu. You can do registration, verification, deletion, setting system parameter and viewing other user information by this menu. For further information, please refer to the related session.

4-3. Register new user

New user can only be registered by the administrators. In order to register a new user, the administrator needs to login the system using ID 9999. After the login process, it will bring you into an administration menu. Just press ‘1’ to invoke the “Register” option. Inside, you can choose a user group from the following three choices, “User”, “VIP” and “Admin”. “User” group is the basic users where they can only login to the system by inputting their staff ID and fingerprint. “VIP” user is more advanced that they don’t need to input their staff ID before placing the finger on top of the fingerprint sensor. When they want to login to the system, they can press enter directly without inputting any number. Then they can place their fingers. The firmware will perform a one to many searching based on the current fingerprint database. If it finds a match, the login process is success. Otherwise, it

fails. “Admin” user differs from a normal user by means that they can use ID 9999 to access the administration menu. For that, it implies that only the administrators can have the rights to register and delete other users.

After choosing the user group, it’s time to input the staff ID. If you have input an existed ID, you might need to start the registration process from the administration menu again. You can choose the login option after you have input the staff ID. The available options are fingerprint and password. Press ‘0’ for fingerprint and ‘1’ for password. Registering using fingerprint is pretty easy. Just follow the instruction to place and remove your finger twice and it’s done. The first time is for enrollment and the second time is for verification. For registering using password, all you need to do is input the password and confirm it with the same password again. The maximum length of a password is 4 digits. No matter which login options you choose to register, you will be brought back to the administration menu after the whole registration process. Doing a verification is a good way to make sure that you have register the user correctly. Please see the next session.

4-4. Verify an existing user

The “Verify” option is used to verify the registered user. Just press ‘2’ inside the menu to invoke that option. Input the user ID that you would like to verify. Then you can ask the user to place his/her finger on top of the fingerprint sensor for verification. The result is shown after he/she has removed the finger. We did not provide verification for users that use password to register.

4-5. Delete an existing user

If a user has no longer needed to login the system, it is wise to delete the user in order to save the storage space. Use this option with care because you will not able to retrieve the user data after deletion. Backup the fingerprint database if you think that you might need to retrieve it later. Pressing ‘3’ inside the menu can invoke the “Delete” option. You can delete a single user or the entire users database. If you delete the whole database by pressing ‘1’, you may need to register a new administrator again before using the program. For deleting a single user, you can press ‘0’. Input the staff ID that you would like to delete. Then confirm it with key ‘1’ and the deletion process is completed.

4-6. Setting the system parameters

System parameters include fingerprint setting, clock and language. You can change these setting by pressing ‘4’ inside the menu to invoke the “Setting” option. Remember to turn to next page by pressing ‘0’ if you cannot find this option in the current page. There are three categories under this option. ‘1’ for fingerprint, ‘2’ for clock and ‘3’ for language.

Two parameters can be set in the fingerprint sub-menu, “Enroll entry” and “Threshold”. “Enroll entry” means the time you need to place and remove your finger during registration. Available entry ranges from 1 to 3. “Threshold” controls sampling accuracy and precision. The lower the number, the higher accuracy and precision it takes to sample a fingerprint. Available threshold ranges from 0 to 100 with 0 the most accurate sampling. The threshold has a direct relationship to the fingerprint matching algorithm. If the sampling accuracy is too high, it is hard for a fingerprint to match an existing pattern because the sensor will reject all uncertain fingerprint image so making the sampling process hard to finish.

Both date and time can be set inside the clock sub-menu. The time input is by means of the 24 hour format. The date input is in the order of year, month and finally day. You need to add an extra zero for single digit month and day. Since the clock will be lost when the power is lost, it is wise to set clock first before using the system for time attendance recording.

The language option can be used to change the display language. Currently, we provide Chinese and English version. However, different language display can also be achieved by upgrading the font database inside the flash.

4-7 Viewing user information

As more and more users are being registered, sometimes we may need to browse the user database in order to keep track of how many users are in our database. The “View” option allows you to browse the user database. Press ‘5’ inside the menu to invoke this option. You can use key ‘4’ and key ‘6’ to browse each user ID. Press ‘Clear’ key bring you back to the administration menu.

4-8. Exit the menu

Pressing key ‘6’ can exit the menu. You can also press the “Clear” to exit from the administration menu. The firmware will enter the standby mode after exit and wait for new staff ID input.

4-9. Displaying real time clock

You can use the “Time” key and the “Date” key to display the current time and date while you are in standby mode. The time and date will go off after 3 seconds. The “Time” key can also be used to enter the debug monitor mode. The “Date” key can also be used to enter the development mode. For further information and procedure, please refer to the related chapters.

5. Using Debug Monitor

5-1. Installation

There are two ways to connect the development board to the PC which make it ready for debug monitor to run. The first one is to use the provided cable with the DB9 pin female connector connected to either COM1 or COM2 at the back of the PC. The second one is to use a null modem cable with both end are DB9 pin female. Then, just plug it into COM1 of the development board and the other end to either COM1 or COM2 interface of the PC. After those connection are made, you can launch a terminal program from PC and set the baud rate to 115200kps, 8 data bit, 1 stop bit and no parity. We recommend you to use Tera Term Pro as it supports binary file transfer so that it can be used to perform firmware upgrade.

5-2. Invoking the debug monitor

To invoke the debug monitor, you need to press and hold the “Time” key while resetting the development board. After the board is reset, you should be able to see the title “Hengyu Technology Ltd.” and a “>” prompt in your windows terminal program. You can try to type “help” and enter to see the list of available commands.

5-3. Commands

help - display help message
usage: help
outpin - output a logic level to a pin
usage: outpin <port> <pin> <value>
inpin - read the logic level from a pin
usage: inpin <port> <pin>
dump - dump the memory content
usage: dump <hex_addr> <dec_length>
trace - show/clear the trace buffer
usage: trace <["show"]|["clear"]>
pulse - generate a square wave to an I/O port
usage: pulse <port> <frequency_Hz>
lcdclear - clear the LCD
usage: lcdclear
lcdchin - display a Chinese character

usage: lcdchin <chin_index> <line> <column>
lcdeng - display a English string
usage: lcdeng <eng_string> <line> <column>
setlang - set the display language
usage: setlang <"chin"|"eng">
clock - display the real time clock
usage: clock
settime - set the local time
usage : settime <hour>:<min>[:<sec>]
setdate - set the local date
usage: setdate <day>-<mon>-<year>
eewrite - write data to the EEPROM
usage: eewrite <hex_addr> <hex_data>
eeread - read data from the EEPROM
usage: eeread <hex_addr>
viewrecord - view the time attendance record
usage: viewrecord
download - download a new firmware
usage: download
exit - exit the debug monitor mode
usage: exit the debug monitor mode

6. Using the Development Mode

6-1. Invoking the development mode

To invoke the development mode, you need to press and hold the “Date” key while resetting the development board. After the board is reset, you should be able to see the title “Development” on the LCD. The development mode receive commands from the UART interface through the COM1 connector.

6-2. Communication setting

The communication protocol is byte oriented. Both sending and receiving bytes are in hexadecimal format. For 16-bit and 32-bit data, low byte is sent first while the high byte is sent later. The communication parameters are as follows,

Baud rate: 115200bps
Data: 8 bits
Stop: 1 bit
Parity: None
Flow control: None

6-3. Communication protocol

Byte order:

If not specified, low byte will be sent first for data longer than 1 byte

Format:

Host to Module:

Header	Len	Command	Data	Checksum
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Header: Communication header, 1 byte
From host to module: 0xAA

Len: Byte length counting from Header to Checksum inclusively. 4 bytes long with low byte sent first.

Command: Command, 1 byte

Data: Data

Checksum: 2 bytes

Checksum1: Arithmetic sum from Header to Data inclusively

Checksum2: Exclusive ORed result from Header to Data inclusively

Module to Host:

Header	Len	Command	Status	Event	Data	Checksum
--------	-----	---------	--------	-------	------	----------

Header: Communication header, 1 byte

From module to host: 0xAD

Len: Byte length counting from Header to Checksum inclusively. 4 bytes long with low byte sent first.

Command: Command, 1 byte

Status: Communication status, 1 byte

Success: 0x10, Error: 0x90

Event: Operation event, 1 byte

Data: Data, variable length depends on the command type

Checksum: 2 bytes

Checksum1: Arithmetic sum from Header to Data inclusively

Checksum2: Exclusive ORed result from Header to Data inclusively

Command Overview:

Command	Description
0x01	LED control
0x02	7-segment LED blanking rate control
0x03	7-segment LED numeric display
0x04	7-segment LED clear
0x05	LCD English display
0x06	LCD Chinese display
0x07	LCD clear
0x10	Enroll fingerprint
0x11	Verify fingerprint
0x12	Search user using fingerprint
0x13	Delete fingerprint
0x14	Delete all fingerprint
0x15	ID existence
0x16	Get fingerprint count
0x17	Get maximum fingerprint template can be stored
0x18	Download fingerprint template
0x19	Upload fingerprint template using ID
0x1A	Upload fingerprint template using slot number
0x1B	Get the fingerprint capture threshold
0x1C	Set the fingerprint capture threshold
0x40	IO control
0x41	Standby
0x42	Power up

Event Overview:

Event	Description
0x00	Enroll success
0x01	Enroll fail

0x02	Verify success
0x03	Verify fail
0x04	Delete success
0x05	Delete fail
0x06	Download success
0x07	Download fail
0x08	ID exist
0x09	ID not exist
0x10	Transfer fingerprint
0x11	Transfer password
0x12	Header error
0x13	Checksum error
0x14	Search success
0x15	Search fail
0x16	IO Control success
0x17	Download fingerprint template success
0x18	Download fingerprint template fail
0x19	Slot number too large
0x1A	Invalid group
0x80	Operation success
0x81	Operation fail
0xF0	Invalid mode
0xF1	Invalid command

6-3-1. LED control

0xAA	Len	0x01	Status	Checksum
------	-----	------	--------	----------

Status: 0x00 - LED turn off, 0x01 - LED turn on

No return

6-3-2. 7-segment LED blanking rate control

0xAA	Len	0x02	Frequency	Second	Checksum
------	-----	------	-----------	--------	----------

Frequency: blanking frequency

Second: number of seconds to blank

No return

6-3-3. 7-segment LED numeric display

0xAA	Len	0x03	Num	Checksum
------	-----	------	-----	----------

Num: number that need to display ranging from 0 to 9

No return

6-3-4. 7-segment LED clear

0xAA	Len	0x04	Checksum
------	-----	------	----------

No return

6-3-5. LCD English display

0xAA	Len	0x05	Row	Col	byte1	byte2...	Checksum
------	-----	------	-----	-----	-------	----------	----------

Row: the row that start to display

Col: the column that start to display

byte1..byteN: English string that want to display in ASCII format

No return

6-3-6. LCD Chinese display

0xAA	Len	0x06	Row	Col	byte1	byte2..	Checksum
------	-----	------	-----	-----	-------	---------	----------

Row: the row that start to display

Col: the column that start to display

byte1..byteN: self defined Chinese index

No return

6-3-7. LCD Clear

0xAA	Len	0x07	Checksum
------	-----	------	----------

No return

6-3-8. Enroll fingerprint

0xAA	Len	0x10	User ID	Group	Mode	Checksum
------	-----	------	---------	-------	------	----------

User ID: 4 bytes long with low byte come first

Group: user group

0x00: user

0x01: vip

0x02: admin

Mode: storage mode

0x00: fingerprint template is sent to the host after successful enrollment

0x02: fingerprint template is stored inside the flash memory of the module

Return:

0xAD	Len	0x10	Status	Event	Data	Checksum
------	-----	------	--------	-------	------	----------

Status: Success: 0x10, Error: 0x90

Event: 0x00: Enroll success

0x01: Enroll fail

0x12: Header error

0x13: Checksum error

0xF0: Invalid mode

0xF1 Invalid command

Data: If mode is 0x00, the data returned is the fingerprint template which should be 272 bytes

6-3-9. Verify fingerprint

0xAA	Len	0x11	User ID	Mode	Template	Checksum
------	-----	------	---------	------	----------	----------

User ID: 4 bytes long with low byte come first

Mode: storage mode

0x00: verify fingerprint with the template sent to the module

0x02: verify fingerprint with the user id template stored inside the module

Return:

0xAD	Len	0x11	Status	Event	Checksum
------	-----	------	--------	-------	----------

Status: Success: 0x10, Error: 0x90

Event: 0x02: Verify success
 0x03: Verify fail
 0x12: Header error
 0x13: Checksum error
 0xF0: Invalid mode
 0xF1: Invalid command

6-3-10. Search user

0xAA	Len	0x12	Checksum
------	-----	------	----------

Search user with the fingerprint

Return:

0xAD	Len	0x12	Status	Event	User ID	Group	Checksum
------	-----	------	--------	-------	---------	-------	----------

Status: Success: 0x10, Error: 0x90

Event: 0x14: Search success
 0x15: Search fail
 0x12: Header error
 0x13: Checksum error
 0xF0: Invalid mode
 0xF1: Invalid command

User ID: The user ID returned if the search result is positive, 4 bytes

Group: user group
 0x00: user
 0x01: vip
 0x02: admin

6-3-11. Delete fingerprint

0xAA	Len	0x13	User ID	Mode	Checksum
------	-----	------	---------	------	----------

User ID: 4 bytes long with low byte come first

Mode: storage mode
 0x02: delete fingerprint stored inside the module

Return:

0xAD	Len	0x13	Status	Event	Checksum
------	-----	------	--------	-------	----------

Status: Success: 0x10, Error: 0x90

Event: 0x04: Delete success
 0x05: Delete fail
 0x12: Header error
 0x13: Checksum error
 0xF0: Invalid mode
 0xF1: Invalid command

6-3-12. Delete all fingerprint

0xAA	Len	0x14	Checksum
------	-----	------	----------

Return:

0xAD	Len	0x14	Status	Event	Checksum
------	-----	------	--------	-------	----------

Status: Success: 0x10, Error: 0x90

Event: 0x80: Operation success
0x81: Operation fail
0x12: Header error
0x13: Checksum error
0xF0: Invalid mode
0xF1 Invalid command

Count: 4 bytes indicating the number of members

6-3-13. ID existence

0xAA	Len	0x15	User ID	Mode	Checksum
------	-----	------	---------	------	----------

User ID: 4 bytes long with low byte come first

Mode: storage mode

0x02: check ID existence stored inside the module

Return:

0xAD	Len	0x15	Status	Event	Group	Checksum
------	-----	------	--------	-------	-------	----------

Status: Success: 0x10, Error: 0x90

Event: 0x08: ID exist
0x09: ID not exist
0x12: Header error
0x13: Checksum error
0xF0: Invalid mode
0xF1 Invalid command

Group: user group

0x00: user

0x01: vip

0x02: admin

6-3-14. Get fingerprint count

0xAA	Len	0x16	Group	Checksum
------	-----	------	-------	----------

Group: 1 byte. The total number of members belong to this group will be returned

0x00: User, 0x01: VIP, 0x02: Admin, 0xFF: All

Return:

0xAD	Len	0x16	Status	Event	Count	Checksum
------	-----	------	--------	-------	-------	----------

Status: Success: 0x10, Error: 0x90

Event: 0x80: Operation success
0x81: Operation fail
0x22: Invalid group
0x12: Header error

0x13: Checksum error
0xF0: Invalid mode
0xF1 Invalid command

Count: 4 bytes indicating the number of members

6-3-15. Get maximum fingerprint templates can be stored

0xAA	Len	0x17	Checksum
------	-----	------	----------

Get the maximum number of fingerprint templates that can be stored inside the module

Return:

0xAD	Len	0x17	Status	Event	Count	Checksum
------	-----	------	--------	-------	-------	----------

Status: Success: 0x10, Error: 0x90

Event: 0x80: Operation success
0x81: Operation fail
0x12: Header error
0x13: Checksum error
0xF0: Invalid mode
0xF1 Invalid command

Count: 4 bytes indicating the maximum number

6-3-16. Download fingerprint template

0xAA	Len	0x18	UserID	Template	Checksum
------	-----	------	--------	----------	----------

User ID: 4 bytes long with low byte come first

Return:

0xAD	Len	0x18	Status	Event	Checksum
------	-----	------	--------	-------	----------

Status: Success: 0x10, Error: 0x90

Event: 0x08: User ID exist
0x17: Fingerprint template download success
0x18: Fingerprint template download fail
0x12: Header error
0x13: Checksum error
0xF0: Invalid mode
0xF1 Invalid command

6-3-17. Upload fingerprint template using ID

0xAA	Len	0x19	User ID	Mode	Checksum
------	-----	------	---------	------	----------

User ID: 4 bytes long with low byte come first

Mode: storage mode

0x02: Upload the fingerprint template from the module

Return:

0xAD	Len	0x19	Status	Event	Data	Checksum
------	-----	------	--------	-------	------	----------

Status: Success: 0x10, Error: 0x90

Event: 0x09: ID not exist

0x10: Transfer fingerprint
 0x12: Header error
 0x13: Checksum error
 0xF0: Invalid mode
 0xF1 Invalid command

6-3-18. Upload fingerprint template using slot number

0xAA	Len	0x1A	Slot number	Mode	Checksum
------	-----	------	-------------	------	----------

Slot number: 4 bytes long with low byte come first

Mode: storage mode

0x02: Upload the fingerprint template from the module

Return:

0xAD	Len	0x1A	Status	Event	User ID	Template	Checksum
------	-----	------	--------	-------	---------	----------	----------

Status: Success: 0x10, Error: 0x90

Event: 0x10: Transfer fingerprint
 0x19: Slot number too large
 0x12: Header error
 0x13: Checksum error
 0xF0: Invalid mode
 0xF1 Invalid command

User ID: 4 bytes long with low byte come first

Template: 272 bytes long fingerprint template

6-3-21. IO control

0xAA	Len	0x40	Port	Val	Checksum
------	-----	------	------	-----	----------

Port: 0x01: port A, 0x06: keyboard port

Val: 2 bytes data indicating the output of the port

Return:

0xAD	Len	0x40	Status	Event	Checksum
------	-----	------	--------	-------	----------

Status: Success: 0x10, Error: 0x90

Event: 0x16: Output IO success
 0x12: Header error
 0x13: Checksum error
 0xF0: Invalid mode
 0xF1 Invalid command

6-3-22. Standby

0xAA	Len	0x41	Checksum
------	-----	------	----------

Put the unit into standby mode

Return:

0xAD	Len	0x41	Status	Event	Checksum
------	-----	------	--------	-------	----------

Status: Success: 0x10, Error: 0x90

Event: 0x80: Operation success
 0x12: Header error
 0x13: Checksum error
 0xF0: Invalid mode
 0xF1 Invalid command

6-3-23. Power up

0xAA	Len	0x42	Checksum
------	-----	------	----------

Power up unit from standby mode

Return:

0xAD	Len	0x42	Status	Event	Checksum
------	-----	------	--------	-------	----------

Status: Success: 0x10, Error: 0x90

Event: 0x80: Operation success
 0x12: Header error
 0x13: Checksum error
 0xF0: Invalid mode
 0xF1 Invalid command

Callback message while enrolling and verifying fingerprint:

Message	Description
50 80	Place finger
50 81	Remove finger
50 83	Move finger up
50 84	Move finger down
50 85	Move finger left
50 86	Move finger right
50 87	Press harder
50 88	Poor fingerprint quality
50 8A	Enroll success
50 98	No finger

7. Technical Specification

- Power supply: 5V/DC +/- 10% if retrieved from the PS/2 port.
7.5V/DC +/- 5% if connected to an external transformer.
- Current input: Typically 250mA.
- Baud rate for UART communication is fixed to 115200kps.
- Core: ARM7TDMI
- Memory: 512Kbyte Flash
2Mbyte SDRAM
4Kbyte EEPROM
- Display: 122x32 dot matrix LCD
- Input: 16 keys
1 fingerprint sensor
- Port: 2 RS232 ports
1 RS485 port
- Storage: Maximum 468 fingerprint template
- Dimension(LxWxH, mm): 183x130x30