StarFive 赛昉科技

# Using a Button to Control an LED Dot Matrix on VisionFive 2

with Python

Application Note

Version: 1.1

Date: 2023/06/08

Doc ID: VisionFive 2-ANEN-010

# Legal Statements

Important legal notice before reading this documentation.

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# Preface

About this guide and technical support information.

## About this document

This application note provides steps to use VisionFive 2's GPIO pins to make an LED Dot Matrix display with countdown and StarFive logo through an example program with Python.

## Version History

**Table 0-1 Version History**

| Version | Released | Revision |
|---|---|---|
| 1.1 | 2023/06/08 | Updated the method for installing `VisionFive.gpio` package in Preparing Software *(on page 12)*. |
| 1.0 | 2023/05/31 | The first official release. |

## Notes and notices

The following notes and notices might appear in this guide:

- **Tip:**
  Suggests how to apply the information in a topic or step.

- **Note:**
  Explains a special case or expands on an important point.

- **Important:**
  Points out critical information concerning a topic or step.

- **CAUTION:**
  Indicates that an action or step can cause loss of data, security problems, or performance issues.

- **Warning:**
  Indicates that an action or step can result in physical harm or cause damage to hardware.

# 1. Introduction

This application note provides steps to use VisionFive 2's GPIO pins to make an LED Dot Matrix display with countdown and StarFive logo through an example program with Python.

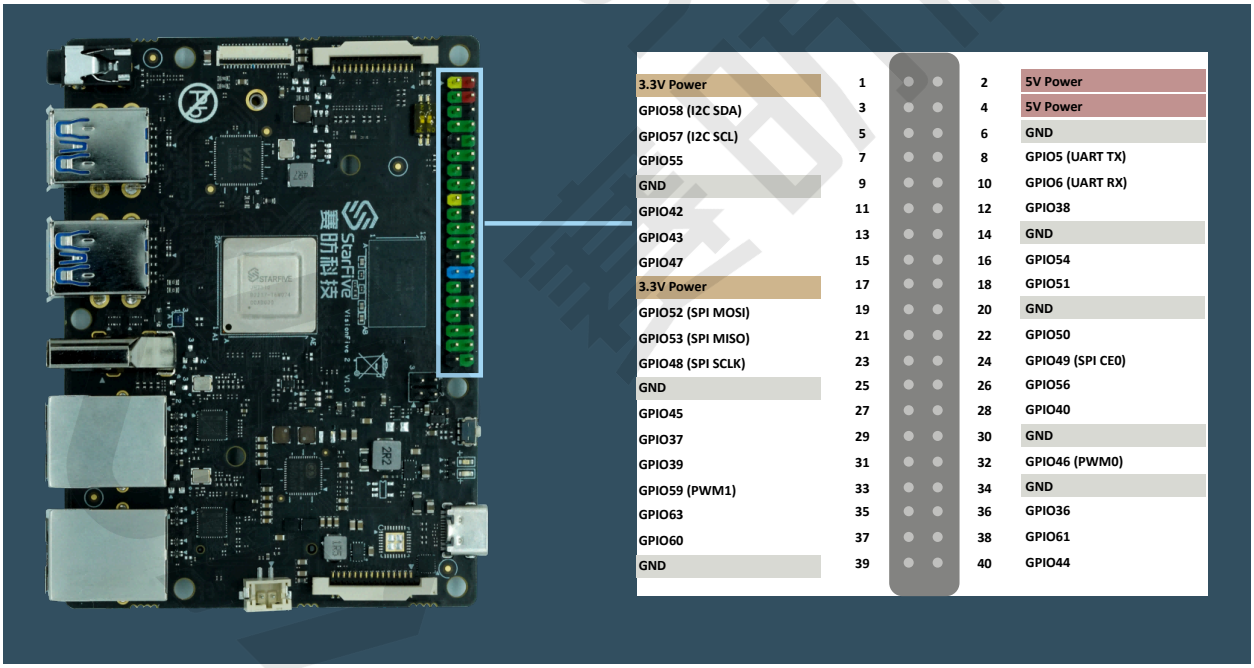
**Tip:**

`VisonFive.gpio` is compatible with the `RPi.GPIO` command, which means that the `RPi.GPIO` python demo can be run on VisionFive 2. In addition, the callback function of API `add_event_detect()` has been optimized compared to `RPi.GPIO`, which adds a *edge_type* parameter in callback function. Therefore, the python demo of `RPi.GPIO` related to callback functions needs to be modified manually by adding *edge_type* parameter.

## 1.1. 40-Pin GPIO Header Definition

The following figure shows the location of the 40-pin header on VisionFive 2.

**Figure 1-1 40-Pin GPIO Header Definition**




**Note:**

The multiplexed pin has been initialized and cannot be used as a general GPIO.

# 2. Preparation

Before executing the demo program, make sure you prepare the following:

## 2.1. Environment Requirements

The environment requirements are as follows:

- Linux Kernel: Linux 5.15
- OS: Debian 12
- SBC: VisionFive 2
- SoC: JH7110

## 2.2. Preparing Hardware

Before executing the demo program, make sure you prepare the following:

**Table 2-1 Hardware Preparation**

| Type | M/O* | Item | Notes |
|---|---|---|---|
| General | M | VisionFive 2 Board | - |
| General | M | • 32 GB (or more) micro-SD card<br>• Micro-SD card reader<br>• Computer (Windows/Mac OS/ Linux)<br>• USB to serial converter (3.3 V I/ O)<br>• Ethernet cable<br>• Power adapter (5 V / 3 A)<br>• USB Type-C Cable | These items are used for flashing Fedora OS into a micro-SD card. |
| Dot Matrix Demo (LED) | M | • An LED<br>• A Breadboard<br>• Seven Male-Female jumper wires | • LED stands for Light Emitting Diode, and glows when electricity is passed through it. The longer leg (known as the 'anode'), is always connected to |

**Table 2-1 Hardware Preparation (continued)**

| Type | M/O* | Item | Notes |
|---|---|---|---|
| | | • A 4-pin button<br>• MAX7219 Serial Dot Matrix Display Module | the positive supply of the circuit. The shorter leg (known as the 'cathode') is connected to the negative side of the power supply, known as 'ground'.<br>• Breadboard: Refer to the introduction below. |

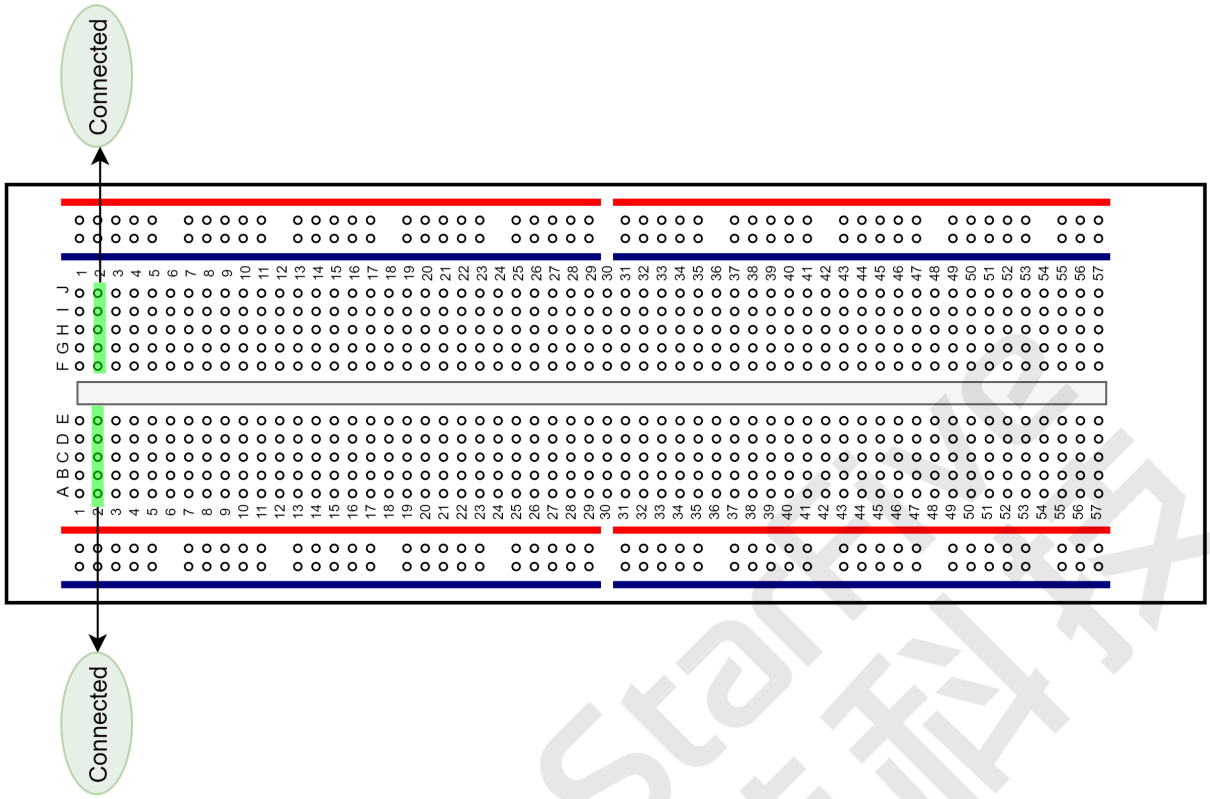
**Note:**
*: M: Mandatory, O: Optional

## Breadboard Introduction

The breadboard is a way of connecting electronic components to each other without having to solder them together. They are often used to test a circuit design before creating a Printed Circuit Board (PCB). As shown in the following figure, there are two lines at the top and the bottom respectively of the breadboard. These two lines are used for power connection: the blue line is for negative and the red line is for positive. Besides, they are divided into two sections, and the holes in each section are connected.

In each column (from A to E, and F to J), holes are connected electrically. In each row (from 1 to 57), holes are not connected.

**Figure 2-1 Breadboard Overview**




## 2.2.1. Hardware Setup

To setup hardware, connect buttons pin ① and pin ② to the breadboard first, and then connect pin ③ and pin ④ to VisionFive 2. The following table and figure describe how to connect button to the 40-pin GPIO Header:

**Table 2-2 Connect button to the 40-Pin Header**

| Button | 40-Pin GPIO Header | |
|---|---|---|
| | Pin Number | Pin Name |
| Pin ④ | 37 | GPIO60 |
| Pin ③ | 39 | GND |

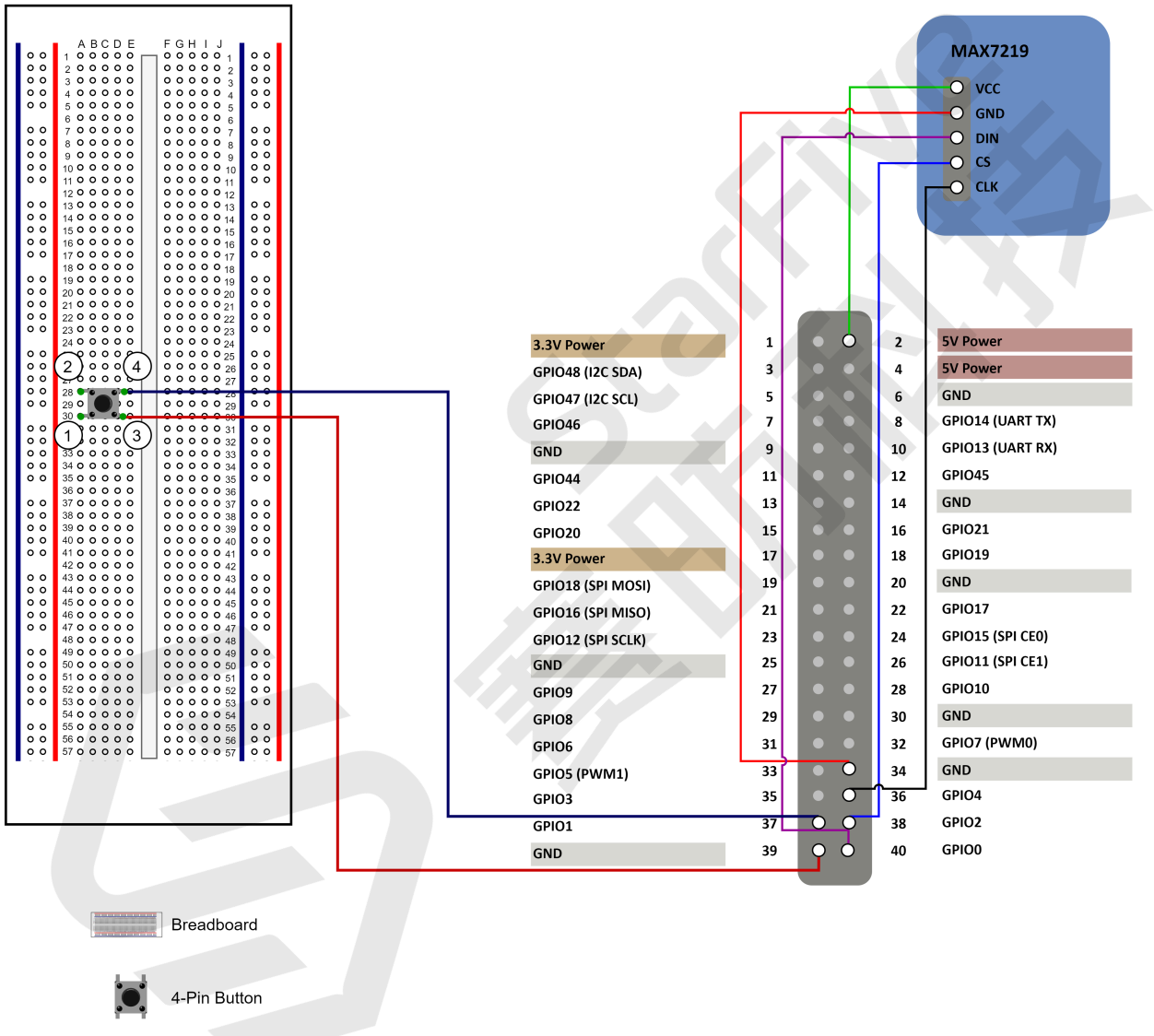
**Table 2-3 Connect MAX7219 to the 40-Pin Header**

| MAX7219 | 40-Pin GPIO Header | |
|---|---|---|
| | Pin Number | Pin Name |
| VCC | 2 | 5V Power |
| GND | 34 | GND |
| DIN | 40 | GPIO44 |

**Table 2-3 Connect MAX7219 to the 40-Pin Header (continued)**

| MAX7219 | 40-Pin GPIO Header | |
|---|---|---|
| | Pin Number | Pin Name |
| CS | 38 | GPIO61 |
| CLK | 36 | GPIO36 |

**Figure 2-2 Connect the button, MAX7219 to the 40-Pin Header**




**Tip:**

Inside the button, the pins ① and ③ are connected while the pins ② and ④ are connected.

# 2.3. Preparing Software

Make sure the following procedures are performed:

**Note:**
The python project, `VisionFive.gpio`, is applicable for VisionFive, VisionFive 2 and JH7110 EVB.

1. Flash Debian OS into a Micro-SD card as described in the *Flashing Fedora OS to a Micro-SD Card* section in the *VisionFive 2 Single Board Computer Quick Start Guide*.
2. Log into the Debian and make sure VisionFive 2 is connected to the Internet. For detailed instructions, refer to the Using SSH over Ethernet or *Using a USB to Serial Converter* section in the *VisionFive 2 Single Board Computer Quick Start Guide*.
3. Extend the partition on Debian as described in *Extend Partition* in the *VisionFive 2 Single Board Computer Quick Start Guide*.
4. Execute the following command to install PIP on Debian:

```
apt-get install python3-pip
```

5. Execute the `pip` command on VisionFive 2 Debian to install the `VisionFive.gpio` package:

   **Note:**
   Due to the fact that `pypi.org` official website does not yet support uploading `whl` installation packages for the RISC-V platform, so it cannot directly execute `pip install VisionFive.gpio` command to install online.

   Please follow the steps below to install the `VisionFive.gpio` package.

   a. Execute the following command to install dependent package:

```
apt install libxml2-dev libxslt-dev
python3 -m pip install requests wget bs4
```

   b. Execute the following command to run the installation script `Install_VisionFive_gpio.py`:

```
python3 Install_VisionFive_gpio.py
```

   The installation script codes are as follows:

```
import requests
import wget
import sys
import os
from bs4 import BeautifulSoup
```

```
def parse_data(link_addr, class_type, key_str):
    req = requests.get(url=link_addr)
    req.encoding = "utf-8"
    html=req.text
    soup = BeautifulSoup(req.text,features="html.parser")
    package_version = soup.find(class_type,class_=key_str)
    dd = package_version.text.strip()
    data = dd.split()
    return data

def parse_link(link_addr, class_type, key_str):
    req = requests.get(url=link_addr)
    req.encoding = "utf-8"
    html=req.text
    soup = BeautifulSoup(req.text,features="html.parser")
    search_data = soup.find(class_type,class_=key_str)
    search_data_2 = search_data.find("a")
    dl_link_get = search_data_2.get("href")
    return dl_link_get

def get_dl_addr_page():
    link_address
 = "https://pypi.org/project/VisionFive.gpio/#history"
    key_str = "release__version"
    class_key = "p"
    data_get = parse_data(link_address, class_key, key_str)
    latest_version = data_get[0]

    dl_addr_page
 = "https://pypi.org/project/VisionFive.gpio/{}/#files".for
mat(latest_version)

    return dl_addr_page

def get_dl_addr_of_latest_version(link_addr):
    key_str = "card file__card"
    class_key = "div"
    addr_get = parse_link(link_addr, class_key, key_str)

    return addr_get

def main():
    dl_addr_p =  get_dl_addr_page()
    whl_dl_addr = get_dl_addr_of_latest_version(dl_addr_p)

    whl_name = whl_dl_addr.split("/")[-1]
    whl_name_suffix = os.path.splitext(whl_name)[-1]
    whl_name_prefix = os.path.splitext(whl_name)[0]
```

```
    whl_name_prefix_no_platform = whl_name_prefix[0:
 len(whl_name_prefix) - 3]
    new_platform = "linux_riscv64"

    rename_whl_name
 = "{}{}{}".format(whl_name_prefix_no_platform,
 new_platform, whl_name_suffix)

    wget.download(whl_dl_addr, out=rename_whl_name)

    os.system("pip install " + rename_whl_name)
    os.system("rm -rf " + rename_whl_name)


if __name__ == '__main__':
    sys.exit(main())
```

# 3. Running Demo Codes

To run the demo code, perform the following on VisionFive 2 Debian:

1. Locate to the directory where the test code, `edge_detection_with_LED_Matrix.py`, exists:

   a. Execute the following command to get the directory where `VisionFive.gpio` exists:

   ```
   pip show VisionFive.gpio
   ```

   **Result:**

   ```
   Location: /usr/local/lib64/python3.9/site-packages
   ```

   **Note:**

   The actual output depends on how the application is installed.

   b. Execute the following to enter the directory, for example, `/usr/local/lib64/python3.9/site-packages` as indicated in the previous step output:

   ```
   cd /usr/local/lib64/python3.9/site-packages
   ```

   c. Execute the following command to enter the `sample-code` directory:

   ```
   cd ./VisionFive/sample-code/
   ```

2. Under the `sample-code` directory, execute the following command to execute the demo code:

   ```
   ssudo python  edge_detection_with_LED_Matrix.py
   ```

   Alternatively, you can execute the following command:

   ```
   sudo python3  edge_detection_with_LED_Matrix.py
   ```

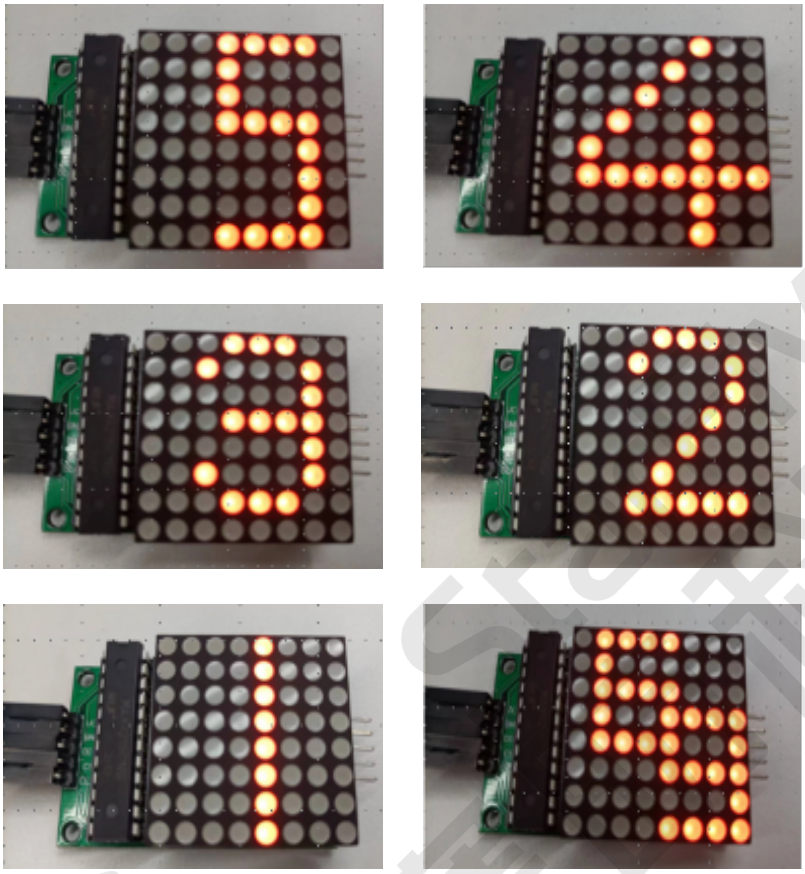
   **Result:**

   - The terminal displays as follows:

   ```
   # python3 edge_detection_with_LED_Matrix.py
   *------------------------------------------------------*
   Please press the key on pin 37 to launch !!!
   ```

- After pressing the button according to the prompt, the LED matrix module will countdown from 5 to 1, and finally display the StarFive logo, as shown in the following figure:

**Figure 3-1 Countdown and StarFive Logo**



# 4. Demo Source Code

The Python source code of this demo is provided for reference purpose only.

`edge_detection_with_LED_Matrix.py`:

```
'''
Step 1:
Please make sure the LED Dot Matrix is connected to the correct pins.
The following table describes how to connect LED Dot Matrix to the 40-pin
 header.
-----------------------------------------
___MAX7219_______Pin Number_____Pin Name
    VCC             2           5V Power
    GND             34           GND
    DIN             40          GPIO44
    CS              38          GPIO61
    CLK             36          GPIO36

Step 2:
Please make sure the button is connected to the correct pins.
The following table describes how to connect the button to the 40-pin
 header.
-----------------------------------------
_______button____Pin Number_____Pin Name
    one end          37          GPIO60
  The other end      39            GND
-----------------------------------------
'''

import VisionFive.gpio as GPIO
import sys
import time

DIN = 40
CS  = 38
CLK = 36
# Configure the direction of DIN, CS, and CLK as out.
GPIO.setup(DIN, GPIO.OUT)
GPIO.setup(CS, GPIO.OUT)
GPIO.setup(CLK, GPIO.OUT)

# Display logo data.
buffer =
 ['01111000', '01000000', '01111000', '01001111', '01111001', '00001111', '0
0000001', '00001111']
# Display arabic numeral 5.
```

```
buffer_5 =
 ["00011110", "00010000", "00010000", "00011110", "00000010", "00000010", "0
0000010", "00011110"]
# Display arabic numeral 4.
buffer_4 =
 ["00000100", "00001000", "00010000", "00100100", "01000100", "01111111", "0
0000100", "00000100"]
# Display arabic numeral 3.
buffer_3 =
 ["00011100", "00100010", "00000010", "00011110", "00000010", "00100010", "0
0011100", "00000000"]
# Display arabic numeral 2.
buffer_2 =
 ["00011100", "00100010", "00000010", "00000100", "00001000", "00010000", "0
0111110", "00000000"]
# Display arabic numeral 1.
buffer_1 =
 ["00001000", "00001000", "00001000", "00001000", "00001000", "00001000", "0
0001000", "00001000"]

# LED turn off data.
buffer_off = ['0', '0', '0', '0', '0', '0', '0', '0']

key_pin = 37

def sendbyte(bytedata):
    for bit in range(0, 8):
        if ((bytedata << bit) & 0x80):
            GPIO.output(DIN, GPIO.HIGH)
        else:
            GPIO.output(DIN, GPIO.LOW)

        # Configure the voltage level of CLK as high.
        GPIO.output(CLK, GPIO.HIGH)
        # Configure the voltage level of CLK as low.
        GPIO.output(CLK, GPIO.LOW)


def WriteToReg(regaddr, bytedata):
    # Configure the voltage level of cs as high.
    GPIO.output(CS, GPIO.HIGH)
    # Configure the voltage level of led_pin as low.
    GPIO.output(CS,GPIO.LOW)
    GPIO.output(CLK, GPIO.LOW)
    sendbyte(regaddr)
    sendbyte(bytedata)
    GPIO.output(CS, GPIO.HIGH)

def disp_clean():
    time.sleep(0.1)
```

```
    for i in range(0, 8):
        # Write data to register address. Finally the LED matrix displays
 StarFive logo.
        WriteToReg(i+1, int(buffer_off[i], 2))
    time.sleep(1)

def disp_numeral_5_to_1():
    for id in range(5, 0, -1):
        buffer_name = "buffer_{}".format(id)
        list_buffer = eval(buffer_name)
        for j in range(0, 8):
            # Write data to the register address. Finally the LED matrix
 displays with numeral from 5 to 1.
            WriteToReg(j+1, int(list_buffer[j], 2))
        time.sleep(1)
        for j in range(0, 8):
            # Write data to the register address. Finally turn off the LED
 matrix.
            WriteToReg(j+1, int(buffer_off[j], 2))
        time.sleep(0.1)

def flash_logo():
    for loop in range(0, 5):
        for j in range(0, 8):
            # Write data to the register address. Finally turn off the LED
 matrix.
            WriteToReg(j+1, int(buffer_off[j], 2))
        time.sleep(0.1)
        for j in range(0, 8):
            # Write data to the register address. Finally the LED matrix
 displays with StarFive logo.
            WriteToReg(j+1, int(buffer[j], 2))
        time.sleep(0.1)


def WriteALLReg():
    # clean screen
    disp_clean()

    # display numeral from 5 to 1
    disp_numeral_5_to_1()

    # falsh starfive logo.
    flash_logo()

def initData():
    WriteToReg(0x09, 0x00) #Set the decode mode.
    WriteToReg(0x0a, 0x03) #Set the brightness.
    WriteToReg(0x0b, 0x07) #Set the scan limitation.
    WriteToReg(0x0c, 0x01) #Set the power mode.
```

```
    WriteToReg(0x0f, 0x00)

# the callback function for edge detection
def detect(pin, edge_type):
    WriteALLReg()

def main():
    # Configure the direction of key_pin as input.
    GPIO.setup(key_pin, GPIO.IN)
    # Both edge rising and falling can be detected, also set
 bouncetime(unit: millisecond) to avoid jitter
    GPIO.add_event_detect(key_pin, GPIO.FALLING, callback=detect,
 bouncetime=2)

    initData()

    print("*-------------------------------------------------------*")
    print("Please press the key on pin {} to launch !!!".format(key_pin))

    while True:
        m = 1

if __name__ == "__main__":
    sys.exit(main())
```

# 5. Resources

Click on this tab to find all SBC relevant resources.

StarFive provides the following resources to guide you through an extraordinary experience on using the VisionFive 2 SBC.

- RVspace Wiki
- Application Center
- Documentation Center
- Technical Forum
- VisionFive 2 GitHub Repository
- VisionFive 2 Debian OS Download
- Code download
- View All PDF Documents

# 6. Buy Now

Click on this tab to find all the online shops and compatible accessories.

## Buy SBC

Use the following page to find your nearest sales channel or the global channels for purchasing a VisionFive 2 Single Board Computer (SBC).

- Buy VisionFive 2

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Use the following page to find the parts that are tested as compatible to VisionFive 2.

- Buy Accessory